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ABSTRACT

In response to the rapidly emerging environmental imperative that environmental awareness needs to be taught in the schools, the Organisation for Economic Co-operation and Development (OECD) through its Centre for Educational Research and Innovation (CERI) developed a project oriented toward grass-roots improvements by schools within environmental education initiatives. Based on the recognition that schools can provide a framework in which to gain experience in investigating, reflecting, and acting upon environmental issues, it was agreed that the participating OECD countries--Austria, Belgium, Denmark, Federal Republic of Germany, Finland, Italy, the Netherlands, Norway, Portugal, Sweden, and Switzerland--should identify those schools that were already developing the most innovative ways of teaching and learning about environmental issues ranging across a spectrum of scientific, economic, and cultural points of view. This report summarizes and gives examples of both the work carried out in these schools, as well as the main pedagogical and strategic issues that provided the basis for this CERI project. Part I, Towards Environmental Awareness, deals with the basic pedagogical premises and provides an in-depth analysis of how these premises have emerged within the work of the selected school programs. Part II, Case Studies, is a series of descriptions and accounts of the 11 schools selected by each of the cooperating countries. Part III, Perspectives, considers environmental and school initiatives from four different perspectives, namely: educational, environmental, industrial, and governmental. An overview of the participating schools is also provided for easy reference and contact information. (JJK)

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FOREWORD

This study was prepared within the framework of the CERI project, "Environment and School Initiatives", by Kathleen Kelley-Lainé of the Secretariat and by Professor Peter Posch, University of Klagenfurt, Austria, in co-operation with experts from OECD Member countries.

After a two-year working period, an international Conference was held in Austria in September 1988, and the results of the Conference were submitted to the CERI Governing Board at its 39th session (December 1988). Members of the Board recommended that the project Environment and School Initiatives be made part of the CERI programme of work.

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PREFACE

Can environmental awareness be taught in the school? This challenging question is increasingly confronting all school systems throughout OECD countries. This publication is the result of two years' co-operation with networks of schools in eleven Member countries.

Responding to the rapidly emerging environmental imperative, and with the strong support of a number of Member countries, the OECD Centre for Educational Research and Innovation (CERI) included within its programme of work a project on Environment and School Initiatives. The idea was first developed at a meeting of the OECD Education Committee at Ministerial level held in Paris in 1984, when Herbert Moritz, then Minister of Education of Austria, underlined that environmental education was one of the most important priorities for the future development of education.

From the very beginning the project was oriented to grass-roots developments in environmental education. It was agreed that participating countries identify those schools that were developing the most innovative ways of teaching and learning about environmental issues — these could range from scientific, economic, to cultural subjects. An important criterion of choice of projects was that students had an important, if not the major, role in defining the project and its objectives; that they took responsibility for carrying them out, and that the aim of their work was to bring about concrete changes in their environment.

The work, therefore, had a double impetus: that of developing "dynamic" qualities in students through active pedagogical strategies, including action research, as well as promoting deeply rooted environmental awareness in students, teachers and those members of the community who came in contact with the project. It was a tacit understanding of participants that young people need to experience the fact that they can contribute to their society through meaningful activities that are respected, and that they can actually influence the reality in which they live. School can provide a framework in which to gain experience in investigating, reflecting and acting on the environment.

This report summarises and gives examples of both the work carried out in the schools and the main pedagogical and strategic issues that provided the basis of the project. Part One deals with the basic pedagogical premises and provides an analysis of how these issues emerged in the work of the schools. Part Two is a series of selected

case studies from the participating countries, with a section devoted to an examination of the criteria for drawing up case studies. Part Three looks at environment and school initiatives from a number of different perspectives — educational, environmental, industrial and policy.

Part One

TOWARDS ENVIRONMENTAL AWARENESS

This publication is the result of an OECD/CERI project, "Environment and School Initiatives", about school initiatives designed to address important challenges in European society. To explore and develop this theme in depth, three specific issues revealed in the course of the project were selected:

The need for environmental consciousness

A massive and broad formation of environmental consciousness is necessary to reach what the Brundtland Report (Report of the World Commission on Environment and Development) called "sustainable development", i.e. development that is not using up the wealth of the past, and living at the cost of the future. Young people are irreversibly affected by present economic, social and technological developments. They must understand this as early as possible. This implies a dual view of the environment: on the one hand it is the world around us, related to man in a functional way and treated as an object of technical rationality. On the other it is a complex system of which man is a part, whose fate is inextricably linked to that of his environment. The environment has both "utility value" and "significance value" (Tenbruck, 1975). Man's self-respect and identity are bound up with and dependent on his respect for the environment and for life. In Albert Schweitzer's words, young people have to understand that "we live in the middle of a life that wants to live".

Example: Students of a secondary school in Norway conducted a marke analysis on the buying habits of the local population regarding detergents, and at the same time provided information on the consequences of phosphates on the environment. They succeeded in modifying buying (and in consequence also selling) behaviour in favour of detergents without phosphates.

The need for meaningful activities

Young people need to feel that they can do something in society that is respected, that they can influence the reality in which they live — in short, that they matter. They need a framework to gain experience in investigating, reflecting and acting on their environment. This is most important, not only because it is considered as a human right of young people, but also because meaningful activities motivate learning.

Example: In Italy four schools co-operate periodically to analyse the surface and ground waters of communities within the framework of normal instruction. After negotiating with the authorities and obtaining their sanction, the students (aged 15-19) take samples, discuss a preliminary analysis on site, make detailed chemical, bacteriological and microplankton analyses at their schools, and submit comprehensive reports to the authorities and other parties concerned.

The need for dynamic qualities

Young people must be prepared to cope with insecurity, to give structure to poorly defined situations, to seek and accept responsibility, and to define problems. This need

is a result of large-scale social changes. Professional, public and private life has become increasingly complex, with divergent and even contradictory demands on the individual within an increasingly pluralistic value system. Above all, it is necessary to look beyond everyday normalities and to search for ethically acceptable options for responsible action. Schools must provide frameworks for young people to develop initiatives and self-reliance and to monitor themselves on the basis of reflected values.

Example: At a secondary school in Austria, students worked out a design for a public park which was given preference over the already existing official municipal design. After many discussions with local politicians and other important personalities, and with the help of experts and the press, they were finally authorised by the community council to plan the park according to their ideas and to supervise its construction.

I. ENVIRONMENT AND SCHOOL INITIATIVES: BACKGROUND AND BASIC PREMISES OF THE PROJECT

Peter Posch

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Universität für Bildungswissenschaften, Klagenfurt, Austria

How it came about

"Environment and School Initiatives" was launched in 1986 by the OECD Centre for Educational Research and Innovation (CERI) in response to a proposal by the Austrian authorities. The idea was first developed at a Conference of Ministers of Education of OECD Member countries held in Paris in 1984, when Minister Herbert Moritz of Austria underlined that environmental education was one of the most important priorities for the future development of education. The CERI Governing Board then decided to include the project in its Innovation Exchange Programme and invited Member countries to volunteer their participation. It was decided that the work would be carried out during a two-year period, ending with an international conference in Linz, Austria to discuss the results.

A first concept was prepared and contained the following guiding principles: the project was to supply findings concerning two relatively new educational responsibilities which are not normally related to each other, the promotion of environmental awareness and the promotion of "dynamic qualities" such as initiative, independence, commitment and readiness to accept responsibility.

The latter is seen as stimulating change and a positive attitude towards economic and technological development. The project is based on the assumption that environmental awareness and dynamic qualities can be regarded as closely interdependent. Improving the environment offers the future development potential for human creativity, intelligence and organisational skills. Thus, it is a challenge to our initiative and creative potential. On the other hand, the development of dynamic qualities has also become crucial, owing to the increasing complexity of work and of social and private life. However, these qualities can only be promoted where they are needed and where opportunities exist for becoming active. The environment provides this chance spontaneously.

Does the connection between environmental awareness and dynamic qualities provide the basis for increased understanding and for innovation of the teaching-learning

process at school? This question was a challenge for the project, anticipating that the experiences of teachers and students would be decisive in revealing the answer. It was important, therefore, to identify schools and teachers who were ready to take part in an innovative educational process, to analyse and document their work, and to practise flexible teaching and learning strategies.

Each participating country was asked to nominate a national co-ordinator and schools or teachers who would be willing to contribute to the project. The following criteria for selecting schools were defined:

i) School initiatives to have four dimensions, of varying degrees of intensity:
   - — Personal involvement of students and their emotional commitment;
   - — Interdisciplinary learning and research;
   - — Reflective action to improve environmental conditions;
   - — Involvement of students, at least partially, in decision-making on problem finding, on procedures and on monitoring their work.

ii) The concept of environment to be a broad one, not limiting school initiatives to the natural environment but including social, economic, cultural and technological dimensions;

iii) The activities of the schools to extend beyond the boundaries between school and community to links with outside institutions;

iv) Different kinds of schools to be represented, including primary, secondary and vocational schools.

In the first phase of the project (1986-1988), schools from eleven countries participated [Austria, Belgium, Denmark, the Federal Republic of Germany (Western Germany before the unification of Germany), Finland, Italy, the Netherlands, Norway, Portugal, Sweden and Switzerland]; additionally, several countries had observer status (e.g. France and Canada). The number of schools per country varied considerably, from one (Portugal) to nine (Austria); in reality, the number was much higher, since in some projects up to 25 other schools co-operated with the officially nominated school.

There were considerable differences between countries in the selection of schools. In some countries, schools that had already acquired national status in environmental project work were asked to participate; in others the national co-ordinators' familiarity with the activities of certain schools provided a frame of reference for selection. In one country (Italy), selection was done more systematically: data from a nation-wide survey on environmental education identified a selected group of teachers who presented their work at a national conference. This procedure had an important side-effect: it provided the data base for a wider national network of environmentally active schools.

Teachers

Participating teachers were asked to accomplish two objectives:

i) In their environmental initiatives, to try to find their own context-specific interpretation of the two general aims of the project and to realise them in relation to each other;

ii) Systematically to reflect on their activities in order to improve them and contribute to their own and others' knowledge of environmental project work; in other words, to involve themselves in action research.

The first of these two goals was immediately taken up by most of the participating teachers and seemed to release additional energy and ideas. The second goal — action research — was more difficult to understand and accept, partly because it was not possible to provide the necessary support and training in the time available, partly because the idea that teachers could produce data on their work seemed too novel. Although all participating teachers produced descriptive accounts of their activities, only a few went a step further and selected issues to be studied in more detail. In Austria, for example, a training programme was set up to familiarise teachers with the ideas and methodology of action research. In a first three-day seminar, experiences were related concerning the gathering and systematic analysis of information on aspects of instructional situations. For the second and third seminars, teachers were asked to keep a research diary of their experiences, to identify issues which they considered important (e.g. specific effects of environmental project work on particular students) and to gather information on the selected issues (e.g. by recording interviews with students). The seminars provided opportunities to discuss observations, to get feedback from other teachers and to find solutions to problems. As a result, each of the teachers produced a case study on an aspect of his work.

National co-ordinators

The national co-ordinators' tasks were to provide logistical support for the teachers, to organise opportunities for communication and training, and to do research and write a report on the state of environmental education in their countries in general and of the "Environment and School Initiatives" project in particular. In most cases the national co-ordinators were experts in environmental education administration or research in their countries. However, only a few of the co-ordinators had additional support structures at their disposal. This proved to be a handicap, especially with regard to the research dimension of the enterprise. In spite of this, however, each expert set up a communication network (primarily through seminars and school visits) with the participating teachers and produced a national report. In a few cases, additional studies were done, e.g. in Austria, where the national co-ordinator interviewed the heads of the project schools on their perception of environmental school initiatives.

International co-ordination

This aspect of the project was carried out by the CERI Secretariat, whose tasks were to organise meetings of national co-ordinators in order to discuss methods of work, design a common framework for national reports, and to prepare the final conference. Three meetings took place, two in Paris and one in Frascati, Italy. It took time to reach an understanding of the basic ideas common to all countries in spite of differing traditions of environmental education. But in the end the foundations for an international network for the exchange of ideas and experiences were laid.

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The project concluded with a one-week international conference and public project exhibition in Linz, Austria in September 1988, attended by 350 participants from 12 Member countries. One hundred and fifty of the participants were students aged 9-19, to whom hospitality was offered by Austrian families. Accompanied by 120 teachers, they took an active part in the conference as well as making visits to schools and exchanging experiences on environmental education with fellow students from Austria. The conference was also attended by administrators from ministries of education and environment, and by experts and researchers in environmental education.

John Elliott, as invited lecturer (see Chapter II below), called the conference a "unique event in the history of international projects concerned with curriculum change". This may be a friendly exaggeration but is not unfounded. The reports and presentations by teachers and students revealed to the conference a wealth of experiences with school initiatives. These ranged from an environmental pillory set up in front of an elementary school (Thomasroith, Austria) onto which pupils put everything they found on the road, thus showing adults the effects of their thoughtlessness, to the reorientation of a whole school's curriculum (Öckerö, Sweden) that reserved one-third of instructional time to project work (greenhouse culture, fish breeding, weekly radio programmes by students, etc.). Students thus acquired competences they could immediately apply when entering or creating jobs on the island (see Part Two and Annex).

Further in-depth analysis was carried out in group sessions on major issues, e.g. quality standards regarding environmental school initiatives, modes of assessment, or the changing role of teachers. The conference ended on a note of high motivation on the part of the participants to continue their work.

Reflections on basic premises

In spite of the great variety of environmental school initiatives, most refer to three common situations:

i) Low-structured, i.e. the problems to be solved have yet to be clearly defined. They therefore differ considerably from the normal instructional situation, in which students are offered pre-structured and systematic information;

ii) Realistic, i.e. they require a holistic approach, cutting across disciplines and stimulating a variety of skills, including creative and organisational. Again, such situations are not normally found in traditional instruction, which is mainly limited to the acquisition of a stock of knowledge;

iii) Developing personal points of view and value judgements in the presence of ambiguity and controversy. Thus, a level of reflection, weighing of evidence, and tolerance for other points of view are needed which normally cannot be expected from discipline-based instruction.

In low-structured, realistic and controversial situations it is difficult to present students with pre-set tasks and predefined curricular contents. On the other hand, a considerable amount of established knowledge is needed to be able to cope successfully with such situations. This dilemma created many problems for the teachers concerned:

i) A tendency to push environmental school initiatives towards the margin of school activities and into the leisure time of both students and teachers;
ii) Little understanding of the teachers' activities on the part of their colleagues;
iii) Students and teachers being sometimes involved in public controversies and conflicts.

In some schools, environmental projects have become an integral part of instruction and have led to a transformation of normal instruction. The Water Analysis Project of the four schools in Mantova, Italy (see Part Two) is an impressive example of this process. The project is completely integrated into normal instruction and thus has a stable institutional basis. In other schools and school systems there are structures that at least favour such activities. In most cases, however, environmental project work is an extra-curricular activity resting on the shoulders of especially committed teachers, of strong personalities who do not feel the urge to be loved by everybody.

The problems encountered in traditional instruction are considered normal. Problems encountered in project work seem to confirm its deviant character and to justify its rejection. This tension is easier to understand if we start from the assumption that, owing to its open structure, its uncertainties and turbulences, project instruction cannot be located at the centre of our notion of school, but rather belongs to its periphery. Centre and periphery are mutually dependent (Strohmeier, 1987). The centre provides stability for the periphery, and the periphery provides the centre with innovations. However, the centre can only be stable if it protects itself from peripheral turbulences.

Teachers who participate in environmental projects are, metaphorically speaking, sitting on the fence at the periphery of the school system. They are both part of it and part of other systems. Communication between centre and periphery is conflict prone because it jeopardises the stability of the centre and thus the functioning of the whole system.

On the one hand a certain destabilisation is a prerequisite for the incorporation of new developments, i.e. for innovation and adaptation to new demands. On the other hand, vigilance and scepticism are crucial for the survival of the centre, since not every peripheral activity is capable of promoting the system's evolution. At present these tensions are particularly threatening because, owing to social changes, schools will probably be confronted with more profound changes than ever before (see Part Three). An extended concept of learning is emerging which is both threatening and promising: learning not only as the transmission of knowledge but also as a process of joint search, joint experimentation and a joint formation of awareness of different possibilities in the future (Fischer, 1987). Teachers who take on this responsibility must communicate with each other, and they need external support through co-operation with non-school institutions, through national and international projects, meetings, networks, etc.

This, however, is not enough. A good teacher is now no longer satisfied with imparting systematic knowledge and often exceeds the limits set by the school, even while accepting low-structured situations. He must be increasingly aware of what he does through systematic reflection on his own actions in order to keep check on the risks connected with environmental projects and in order for him and others to learn

from their successes and failures. This is a strong argument in favour of the action-research dimension of the "Environment and School Initiatives" project and of encouraging and supporting teachers to evaluate their work with students, to communicate and thus contribute to professional knowledge (see Part Two).

As regards the further development of environmental school initiatives, three perspectives seem most important:

i) Expansion of the network of schools involved and the improvement of national and international exchange on these experiences;

ii) Dynamic development of support structures for environmental school initiatives;

iii) Strengthening of research activities, especially of knowledge production by the teachers themselves.

These are ambitious and long-term targets, and the first phase of this project was but an initial step towards their realisation.

II. ENVIRONMENTAL EDUCATION IN EUROPE: INNOVATION, MARGINALISATION OR ASSIMILATION

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The major purpose of "Environment and School Initiatives" was to examine the feasibility of a certain concept or goal of environmental education within a variety of educational systems, and to further refine the standards and principles implied. The action-research task of participating schools and teachers was to document, in the form of case studies, their attempts to achieve a certain goal of environmental education, and to clarify that goal further. The action-research task of the national co-ordinators was to document the challenge of co-ordinating and facilitating the project within their national context.

I was commissioned to produce a report based primarily on documentation submitted by the national co-ordinators and participating schools. My involvement does not rest on any expertise within the specialised field of environmental education. It rests on the fact that I have played a role, both within the United Kingdom and internationally, in the development of educational action research as a way to bring about curriculum change.

This approach brings educational research into a different and non-traditional relation with educational practice. In action research, educational inquiry is not considered as separate from educational practice. The latter is seen as a mode of inquiry into the problems and possibilities of achieving educational aims and values. Actions are viewed as hypothetical strategies for realising such goals, based on practitioners' deliberations about the practical problems which arise in concrete situations, and are self-evaluated and monitored.

In action research, educational inquiry does not focus on means alone. Concepts of educational aims and values are clarified and articulated by practitioners as they reflect about the actions they take to realise them. Action research is not a form of technical or instrumental means/ends reasoning because means and ends are investigated jointly. It is a process which aims both to improve practice and to develop better theories to guide it. Hence, action research not only increases our understanding of how to achieve an innovatory curriculum concept in local and national contexts, but also further develops that concept.

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This chapter summarises the teachers' and national co-ordinators' insights into the nature of environmental education and the necessary conditions for its implementation in school systems. It also assesses the extent to which the initiative has successfully established action research as a basis for curriculum development in the field of environmental education. This is a second-order task which depends in part upon the quality of the documentation submitted. How did it describe the project in action to a reader who had no such direct experience? This requires not simply providing surface descriptions of activities, processes and transactions, but also of communicating the feelings, attitudes, perceptions and understandings of those involved.

The quality of the documentation varied: there was a tendency for teachers to provide surface rather than in-depth descriptions of the project. Surface descriptions simply report factual information about the objective features of things and events. In-depth descriptions set the objective features in a context of subjective meanings which depict how people experience things and events, how they feel about, perceive and understand them. Some of the national reports by co-ordinators were extremely helpful in summarising implementation problems in the national context, but there were few concrete examples of how these problems were experienced and responded to in participating schools.

The Austrian documentation was generally of a high quality. It was based on systematic action research carried out by both the national co-ordinator and many of the project leaders in schools. As a result, it was possible to develop a clearer view of schools' implementation issues in Austria than in other countries. The emergence of action research as a basis for curriculum development in the field of environmental education is explained by the fact that the national co-ordinator and participating teachers had access to the project consultant at the University of Klagenfurt, where over the past decade he has been involved in developing action research for resolving the theory/practice problem in education. Participating teachers also received some in-service training in the methodology of action research.

Little trace of this training was found in the documentation from other countries, which does not imply that their case studies and reports provided no evidence of being grounded in an action-research process. Many teachers' case studies were impressive in the extent and depth to which they developed the concept of environmental education. There was of course variation as to which aspects of the process were focused upon and highlighted. Some stressed aspects that could be linked to problems of securing student motivation and commitment, while others described those related to problems of influencing action within the local community. In other words, variations in the treatment of different aspects of environmental education could be explained by teachers' perceptions of the practical problems they encountered in their particular educational settings.

This indicates that the process of developing useful theories of education cannot be divorced from the process of reflecting about concrete problems which practitioners encounter in particular situations. Had the teachers not reflected a great deal upon their practices, they could not have generated such clear ideas about the nature of environmental education. Moreover, it is interesting that although they emphasize different theoretical aspects, most of the ideas expressed in the case studies are consistent with

the broad concept of environmental education as outlined in the background papers prepared for launching the project. Together, these ideas constitute an internally consistent and coherent theory of environmental education which elaborates and extends the theoretical groundwork. It is important that teachers have a good grasp of the relevant knowledge and techniques of inquiry, but their competence as teachers depends on more than subject expertise: it depends on their ability to use this expertise in a worthwhile process of education. A subject expert might look at the documentation for the extent to which teachers were transmitting accurate, relevant and comprehensive knowledge and skills, whereas I have looked at it for teachers' conceptions of the environmental education process and their perceptions of the problems of putting it into practice. This seems entirely consistent with the project as it was originally conceived, since the project is concerned with implementing a certain concept of an educationally valuable process for handling environmental topics/themes, and utilising appropriate subject knowledge and skills.

If insights into implementation problems/issues are to be taken out of the realm of private experience and into that of public discourse via action research, then teachers and other educational innovators need to develop a methodology for accomplishing this. It is an important task for CERI in its role as co-ordinator of international programmes of curriculum development and reform. Until this is achieved, the data base for comparing and contrasting innovation problems and possibilities across educational systems will be limited. And this will constrain the quality of international discourse on the problems surrounding educational innovation.

Some may argue that public access to this kind of qualitative data can only be secured by the efforts of outside researchers based in universities with expertise in qualitative methodology. However, this approach splits the process of knowledge generation from the process of development, and creates problems for the utilisation of knowledge by those participating in the development. Action research makes knowledge generation an integral part of the development process and thereby obliges participants to utilise knowledge. As a basis for international development it requires all those participating continually to exchange their experiences and insights across local and national contexts through dialogue.

The 1986-88 phase of the project concluded with a conference and exhibition in Linz in September 1988 which brought together students, teachers and administrators from the participating countries. It was a unique event in the history of international projects concerned with curriculum change. The exhibition showed the various local projects, the environmental problems studied, and the pedagogical issues which emerged from teachers' and students' experiences. It provided an excellent data base for exploring the questions, issues and possibilities which need to be addressed during the next phase of the initiative. The Linz conference was part of an action research-based learning system: it involved the sharing of data and the development of new insights which can be used in further development.

This report is an attempt to distill common insights and understandings amongst project participants about environmental education and the problems and possibilities of achieving it in action. The organisation of the project, however, placed constraints on the development of an action-research process. Many of the national ministries of edu-

cation were slow at initiating preparatory arrangements, which left national co-ordinators little time and opportunity to induct teachers and schools into the methodology of action research.

The following data base was used to write this report:

- General background papers;
- Reports and background documents produced by national co-ordinators;
- Case studies (approximately 30) submitted by teachers from participating schools;
- Notes on discussions at the national co-ordinators' conference in Rome, 1988;
- Responses to an open-ended questionnaire distributed to national co-ordinators.

These reports are working papers and are not available for general circulation.

How schools and systems responded to the challenge of innovation in the field of environmental education

The original proposal for the project stated two major objectives for environmental education:

i) Imparting an understanding of the complex relationship between man and his environment in all its dimensions, i.e. biological, physical, economic, historical, cultural, etc.;

ii) How concern for the environment can be used to enhance a learning/teaching process which requires students to develop "dynamic" qualities, e.g. taking initiatives with respect to environmental issues, accepting responsibility for the environment, identifying and resolving environmental problems.

The relationship between these two curriculum aims is not fully explained in the proposal and appears at first to be contradictory. Does not "imparting an understanding" imply a passive rather than a dynamic role for students? Such a role would require minimum disruption to the subject-based patterns of curriculum organisation which prevail in most European countries. It would involve some changes to the subject content covered at different age levels. It would also involve the reorganisation of content around environmental topics or themes, and thus require increased collaboration between teachers of different subjects to ensure that content relevant to a particular theme was taught at the same time.

But to what extent would such changes in the content and organisation of the curriculum count as an implementation of this particular innovation? They might leave the teaching/learning process basically unchanged. The proposal presents participating teachers and schools with an apparent dilemma: how do they reconcile a process in which understanding is imparted, with a dynamic process for developing active rather than passive qualities in students? It would seem a potentially fruitful dilemma, since it can only be resolved if teachers, schools and educational systems begin to question their assumptions about the nature of knowledge. In establishing an apparent paradox be-

tween two major aims, participants were challenged to an exercise in epistemology, by questioning tacit assumptions about knowledge which underpin the educational system. Teachers and schools tended to respond to this challenge in either of three ways:

i) Knowledge as the active creation of personal meaning

Knowledge was viewed as the manifestation of students' abilities to ascribe personal meaning and significance to environmental situations (holistic understanding). But this relegated the process which developed these powers of understanding to the margins of the curriculum: to optional subjects for a minority of students, or to extra-curriculum activities, or to a mixture of both.

ii) Knowledge as the outcome of discipline-based inquiry

Subjects constituted not so much bodies of information as disciplines of inquiry or activities of knowledge production governed by standard techniques and procedures for collecting, analysing and interpreting. What needed to be learnt was not simply information (although this was involved) but the techniques of analysis which generated valid knowledge in environmentally relevant disciplines.

Environmental education, conceived as a form of discipline-based inquiry, tended to operate with older students. This is because the methods of inquiry within disciplines of knowledge presume the acquisition of certain key concepts and theories before such methods can be mastered.

iii) Knowledge as bodies of information organised as subjects

This conception of knowledge has already been referred to. It emphasizes a passive student role of rote-learning and a pedagogy based on information processing techniques. Schools which maintained this conception of knowledge tended to assimilate the project into the mainstream curriculum and neglected the project's second aim, i.e. the development of dynamic qualities. They did not respond to the challenge of the dilemma. Innovation in this context simply consisted of fine-tuning the existing curriculum to make it relevant to environmental themes.

These three types of response are all evidenced in the documentation to a greater or lesser extent. Some local projects revealed unresolved tensions between all three forms of response, and their implications for the school curriculum. But this preliminary classification of responses to the initiative provides the central questions to be addressed:

— What principles, criteria and standards enable us to judge the extent to which the project's concept of environmental education is realised in practice?
— Did the schools achieve the project's innovatory concept of environmental education within their mainstream curriculum provision?
— How does one explain a tendency to place the innovation at the margins of the curriculum? In which educational system is this tendency most marked?

— In what ways do school systems assimilate the innovation with their existing curriculum? How does one explain these assimilation tendencies? In which educational systems were they most marked?

— Did the initiative foster any changes in either content and organisation of the curriculum, or the process of learning and teaching? Or did it simply enable already existing "innovations" to be documented and reporter? If the latter, then what can we learn from such schools in attempting to bring about desirable change in non-innovatory schools?

The last questions arise because the schools were deliberately selected for their reputation for innovation in environmental education. The project was concerned with documenting existing innovatory practices, as well as stimulating development consistent with its aims. The initiative enabled schools to enhance their status as innovators in environmental education, and by implication enhanced their respective ministries' international prestige. Such motives are not to be despised, but if they were the dominant rationale for participation, they may have obstructed a major purpose of the initiative: to promote an action-research process which required teachers to reconcile "environmental awareness" and the "development of dynamic qualities" as curriculum aims.

The desire for national and international recognition may also explain the style of some of the reports which presented a highly favourable image of the work of the schools, teachers and administrators involved. An initial hypothesis in response to the second central question is that the initiative has not yet succeeded in implementing the concept of environmental education as outlined in the original proposal, within the mainstream curriculum of participating countries.

The most significant evidence for this assumption is the almost total lack of reference in any of the case studies to systematic assessment of the dynamic qualities which it was hoped the process of environmental education would develop in students, since any innovation which established such a process within the mainstream curriculum could not avoid the problem of assessment. If this is true, then the innovation was either placed on the periphery of the curriculum where assessment is not regarded as so important, or assimilated into existing teaching/learning processes where outcomes are assessed by established methods. This implies that the development of appropriate forms of "profiling assessment" must be given high priority when the initiative moves into its next phase. This recommendation is supported by the Austrian and Norwegian national reports.

If the hypothesis is valid, it would be a mistake to conclude that the initiative has failed. It has helped to deepen understanding of the conditions which contribute to the success or failure of its aims, and these lessons can be incorporated in the next phase. We often underestimate the challenge of bringing about fundamental change in educational systems.

Moreover, the documentation does suggest that the reported innovations represent steps towards achieving an innovatory concept of environmental education. Even the revision of existing curricula around environmental themes is a step in the right direction, but by itself it does not lead to any change in the education process. Rather, it can be viewed as a necessary precondition of such change. Similarly, the transition from a

process which emphasizes information processing to one of discipline-based inquiry may be a further step in the right direction. It may not be sufficient for developing the kind of holistic experience-based understanding the initiative had in mind, but the analytic and technical skills it fosters play a role in such development. Even the marginalised implementation which is consistent with both the project's curriculum aims enables schools and administrators to assess the educational potential of the innovation for the mainstream curriculum, and provides a perspective from which to review such provision.

It is important to ensure that the innovation process in environmental education does not get blocked at a particular level of development, and this must be a priority for the next phase of the project. The major strategy for ensuring this must be a teacher training scheme for facilitating reflective practice or action research as a basis for development, both in schools and in the wider educational system.

The environmental education process: criteria and standards

The two aims of the project represent an attempt to overcome a duality in the educational system. The promotion of environmental awareness in schools is frequently associated with a conservationalist spirit and hostility towards economic and technological development. On the other hand, the development of dynamic qualities in students is believed to be important for the economic and technological development of society. Posch argues above that the personal qualities required for wealth creation activities in society can also be developed through an education process which promotes environmental awareness:

> *The project is based on the assumption that environmental awareness and dynamic qualities can be regarded as closely interdependent. Improving the environment offers the future development potential for human creativity, intelligence and organisational skills.*

This view is not an attempt to highjack entrepreneurialism in the service of a partisan cause, and it need not reflect an anti-technology and anti-wealth creation bias. This is made quite clear in the original proposal from the Austrian Ministry in 1986:

> *For some Member countries such as Austria, Canada, the Nordic countries and Switzerland, whose major economic interests are intricately bound up with their natural resources, questions of the environment are immediately linked to pragmatic survival. For these Member countries, the teaching of environmental studies is a necessary part of the school curriculum* (OECD, 1986*b*).

Policy-makers in many European societies are now aware that questions of technological and economic development are inextricably bound up with the protection and conservation of the natural environment. The environmental and economic dimensions of human activity can no longer be separate problem domains in everyday life within many societies. This explains the statement made at the Conference of Ministers of Education of OECD Member countries in 1984 by Herbert Moritz, then the Austrian Minister of Education. He argued that environmental education was one of the most important priorities in the future development of education.

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It may be questioned why certain Member countries did not give this initiative sufficient priority. Were the policy-makers of these countries less aware of the environmental/economic interdependence than those who did participate? That was two years ago, however. Societies change and political responsiveness of policy-makers often follows a cultural transformation in which environmental issues emerge high on the agenda of social discourse, and where different points of view cannot easily be classified in terms of allegiance to a political party or as capitalism vs. socialism. It is important that Member countries who did not participate in the initiative have an opportunity to do so during the next phase.

This leads to the formulation of a hypothesis about the social and cultural preconditions for implementing the project's dual aims within the mainstream curriculum: environmental issues must become prominent subjects of debate within society, and defy simple classification along party political lines, before environmental education becomes a priority for curriculum policy-making.

Many of the national reports provide clear evidence of how attempts to accommodate environmental education within national curriculum frameworks have followed the emergence of environmental concerns within these countries. These reports (especially those from Austria, Italy, Finland, the Netherlands and Norway) raise a fundamental issue. Most of the curriculum revision has consisted of attempts to adapt the existing subject-based curriculum to make course content more environmentally relevant and to establish thematic interdisciplinary links. In some countries (e.g. Finland and Austria), national guidelines allow for periods of project work in environmental education outside the subject boundaries and conventional patterns of timetabling. But in general, teaching and learning remain organised around subjects, and the established framework remains basically unchanged. Adaptations to accommodate environmental education have not undermined the dominant conception of knowledge which underpins this framework: that of information acquired through passive recall learning. The national reports provided little evidence that participation in the initiative has so far resulted in any fundamental revision of national curricula. However, progress during the next phase of the initiative will depend upon the willingness of participating countries fundamentally to review existing patterns of curriculum and instruction in the light of the project aims.

Such a review would have implications not only for the place of environmental education in the curriculum but would challenge the general assumptions about education. As some national reports make clear (e.g. Austria and Denmark), existing patterns promote passive rather than dynamic qualities in students. The aims of the Environment and School Initiatives project imply a process of teaching and learning which has implications for the curriculum as a whole. Some national reports (those of Austria, Denmark, the Netherlands and Norway) also point out that there is little provision, at either pre- or in-service levels, for training teachers to handle the kind of project-based education the initiative promotes. Another priority at the next phase should be a review of the pre- and in-service training provision within teacher training institutions.

In the light of these considerations, it is important to clarify the principles and criteria which are embodied in the project's aims. The background papers contain a number of ideas from which to build a theory of environmental education and, more

generally, a theory of education which underpins the initiative. By making the theory explicit, we can begin to resolve the apparent contradiction between the project's two aims. It is not necessarily a contradiction for a curriculum proposal to state ambiguous aims, since this leaves room for teachers to participate in theory development while reflecting upon their practices. One significant achievement of the project is to have revealed through the case studies the potential of teachers as curriculum theorists. Environmental awareness or understanding is not considered simply as an aggregation of piecemeal knowledge about the environment which students acquire from subject instruction. Rather, it consists of a holistic grasp of the practical and complex issue which is raised by human action upon the environment. Holistic thinking is a dynamic process which calls into play active cognitive powers, particularly the power to synthesise parts or aspects of a situation into a complex whole. Moreover, this kind of understanding is inextricably linked with an active involvement with practical problems of environmental quality. Environmental awareness develops not by passively contemplating a problem but by taking action to resolve it. Hence, the Austrian proposal stresses the importance of "learning from experience" and of a curriculum which is "no longer an abstract entity but a course of action, giving young people a sense of immediate responsibility as well as developing their civic skills" (OECD, 1986*b*).

In this view, the development of environmental awareness cannot be separated from the development of dynamic qualities: cognitive qualities such as the ability to synthesise parts into complex wholes, to discover patterns in complex data, to look at situations from different angles; reflective qualities such as the ability to monitor one's actions in relation to the quality of the environment; affective qualities such as concern for the environment; and qualities of action such as exercising initiative and accepting responsibility for the environmental consequences of an act.

These personal qualities of thought, feeling and action are activated by a process in which understanding and action are inextricably linked via cycles of reflection-action-reflection. As an outcome of this process, environmental awareness or understanding is a form of practical wisdom developed through reflective action. This process for developing understanding is a process of action research.

The project does not use the term action research to describe the learning process. Instead, it refers to project or active learning, which the background papers clearly view as a process of inquiry. But inquiry learning tends to be interpreted by teachers of subjects as a process by which students discover subject knowledge or facts. Project or active learning is therefore interpreted as discipline-based inquiry and becomes assimilated into the existing subject-based curriculum structures. This is not necessarily undesirable, since it can develop higher levels of understanding of facts and concepts than a memory or recall learning process. But this kind of understanding is essentially analytic rather than holistic. It calls upon students' analytic powers of understanding in relation to theoretical problems rather than on their powers of synthesis in relation to practical ones.

The development of analytic understanding through discipline-based inquiry has an important role in developing environmental awareness: that of constituting knowledge which can be used in assessing environmental problems holistically. But it is not sufficient, as the Italian and Norwegian national reports point out. Such knowledge needs to

be integrated via the development of holistic understanding, and discipline-based inquiry is therefore a foundation for, but subordinate to, the development of holistic understandings of environmental problems through action research. These two forms of inquiry should not be conflated. Terms such as project or active learning are not helpful in this respect.

Standards for the environmental education process

The major criteria implicit in the project's conception of environmental education appear to be:

Criterion 1: Environmental awareness is a type of practical wisdom developed through a form of action-based inquiry or action research.

This criterion is implicit in and informs four of the project's guiding principles which, as Posch shows (Posch, 1988), inspire students to:

i) Approach the environment as a sphere of personal experience;
ii) Examine the environment as a subject of interdisciplinary learning and research;
iii) Shape the environment as a sphere of socially important action;
iv) Accept the environment as a challenge for initiative, independence and responsible action.

Criterion 1 throws light on the project's concept of interdisciplinarity and on what is meant by "a sphere of personal experience". Action research is a form of interdisciplinary inquiry because it involves the synthetic utilisation of knowledge from various disciplines in developing a holistic understanding of complex, concrete and practical problems. What determines the integration of subject knowledge is not its relevance to an abstract concept but to someone comprehending a particular concrete situation in which they are agents and therefore a part. The criterion distinguishes between a concept of interdisciplinarity stressing discipline-based inquiry, and a concept which refers to the eclectic utilisation of analytic knowledge through students' action research.

The principle that students should "approach the environment as a sphere of personal experience" is also open to different interpretations. Posch warns against the danger of viewing the environment exclusively from an objectivist perspective as "that which surrounds" human beings. This perspective gives rise to the idea that the environment is related to man "in a functional way only" and that it has no "significance value", only a utilitarian one. He argues that we must understand ourselves as part of our environment, that human beings' attitudes towards themselves and towards the environment "may not be separated from each other". In other words, environmental awareness is an awareness of the potential or actual relationship between our actions and other elements in what Posch calls the "fellow world" (Posch, 1988).

This view of the man/environment relationship is consistent with Criterion 1. Through an action-research process of learning, students reflect upon their experience of living within the environment, identify the problems which emerge from man/environment transactions, and develop and test practical solutions to these problems. The principle that students should "approach the environment as a sphere of personal expe-

rience" is therefore coherent with the third principle cited by Posch — that students are expected to participate in shaping the environment "as a sphere of socially important action". It is also consistent with the fourth principle that students should "accept the environment as a challenge for initiative, independence and responsible action".

There are interpretations of the principles of interdisciplinarity and personal experience which are inconsistent with Criterion 1 and break the coherent relationship between all four principles. These interpretations also create conflict between the dual aims of the project. We therefore need two further criteria for the environmental education process envisaged by the project, namely:

> *Criterion 2:* The development of environmental awareness should involve students reflecting upon their own personal actions in the environment in which they live.
>
> *Criterion 3:* The environmental education curriculum should focus on practical problems of living within the environment which are experienced by students as problems and issues related to their own actions.

When interdisciplinarity dissociates the acquisition of knowledge about the environment from helping students to identify, clarify and resolve a practical problem of living within the environment, then the learning process fails to conform to all three criteria. The case studies and national reports often cite evidence of the ways in which existing boundaries between subjects, traditional modes of instruction, and the ways students are grouped all make it impossible to facilitate a process in which knowledge is not only acquired but utilised by students for understanding and solving their own problems of living within the environment. Teachers' intentions were often clearly articulated in a form which reflected the three criteria standards. For example:

> *The emphasis on experiential, experimental and skill-based learning points out the difference between "what we can teach children about the environment" and "what are children's experiences and perceptions, and how might these be enriched and developed?"* (Santos and Montaliz, Portugal, 1988)

Teachers are not denying the importance of knowledge acquisition but asking how it can be acquired to enrich students' perceptions of their practical problems of living within the environment. They are claiming that knowledge acquisition be integrated into a process enabling students to clarify and resolve these problems, which are real and personal for them. When the interdisciplinary acquisition of knowledge is part of an action-research process of learning, it ceases to be passive because students will exercise a high degree of control and initiative in defining what they need to know and in the interplay between the dimensions of knowledge acquisition and knowledge utilisation. The interplay between these two dimensions in environmental education was well described by another Portuguese teacher:

> *Future adults must be educated in an integrated way so that their knowledge may be duly articulated in itself and in relation to reality. This project is certainly one of the best ways to achieve these goals... I asked the pupils about the main environmental problems of their everyday life.* (Chito, 1988, in an interview about the project)

This process is also described by an Austrian teacher:

> *From my experience I believe that the necessary special knowledge required for a certain problem becomes relevant and is looked for only when a concrete and specific issue has been raised.* (Kvarda, 1988)

These examples imply that interdisciplinary connections are established within the process of teaching and learning and not in advance of it. Such a concept is clearly different from one which views integration in content rather than process terms, i.e. as establishing links between the content of subjects prior to, and independently of, the teaching/learning process, for example in relation to abstract themes. Establishing content links in advance of the process may be important for planning a data base which supports the learning process, but it should not be allowed to determine that process. The implementation of a process concept of curriculum integration appears to be critical for the development of dynamic qualities in students. This point is made in the Belgian case study in Part Two:

> *While conducting the project, we assumed that education as a whole would be promoted by a direct confrontation with reality and thereby be experienced in a broader and more intensive way. A sense of initiative, self-discipline, team work, open dialogue and co-responsibility all came into relief.*

The project concerned an ecological study of a coastline in connection with pollution problems in a fishing community, and it involved teachers of biology, chemistry and geography, and an audio-visual expert. Traditional timetabling was replaced by a planned cycle of environmental education project weeks spread over three years (4th, 5th and 6th years of secondary education). The absence of organisational boundaries between subjects and of the constraints they impose on integrating knowledge acquisition with knowledge utilisation, enabled students' dynamic qualities to emerge.

In the light of these considerations about the nature of interdisciplinarity, a further criterion needs to be articulated:

> *Criterion 4:* Knowledge and skills from different subjects and disciplines should be eclectically integrated as they are utilised by students within an action-research learning process focused on their personal problems of living in the environment.

The teachers' case studies show that when interdisciplinarity has guided practice, an even greater range of subjects is called into play than those concerned with knowledge acquisition. Not only are the natural sciences and geography regarded as relevant subjects but also the arts and humanities. These latter subjects play an important role in helping students clarify the attitudes, values and assumptions which underpin their experience of living in the environment and their perceptions of its problems.

> *Art and design activities build on our innate capacities to explore and take control of our environment... They depend not on the acquisition of a body of knowledge but on a preparedness to learn. The work is centrally concerned with developing capabilities to understand, to think about and to take action.* (Santos and Montaliz, 1988)

In other words, the arts — although not directly concerned with knowledge acquisition — are essential for its utilisation. The knowledge-based sciences are integrated in

an action-research learning process together with the arts subjects, as expresssed by the Belgian biology teacher in Part Two:

> *We aimed at integrating knowledge into attitudes by means of skills, in order to contribute to the students' personality formation in the service of the community.*

In the term "personality formation", there is a tacit reference, perhaps, to the development of dynamic qualities. When students are engaged in a process integrating knowledge acquisition with the development of their attitudes and values towards the environment, they are able to develop fully their natural human powers. Such a learning process is unlikely to be successful if it fails to utilise the arts and humanities as well as the natural sciences. There is, then, a fifth criterion for a worthwhile process of environmental education:

> *Criterion 5:* Development of environmental awareness through action research should involve the integration of symbolic modes of representing the experience of the environment (arts and humanities) with analytic modes of generating and acquiring such knowledge (science subjects).

According to this criterion, the project's aims can only be fulfilled by utilising the whole spectrum of curriculum subjects. It is difficult to see how this could be achieved without establishing core curricula in schools which focus on problems of everyday living. Problems concerning the natural environment would constitute one category of such problems, whereas other categories would cover problems connected with the man-built and technological environment, the social, economic and political environment, and the moral and spiritual environment.

The background papers suggest that environmental education should address all the dimensions of man's being-in-the-world. This extends the concept to cover every aspect of human development. However, the innovative examples documented during this phase of the initiative are concerned exclusively with problems of the natural environment. The boundaries of the concept should be discussed and perhaps clarified before the start of the next phase. Subject-based curriculum and instruction could operate outside the core to establish basic general knowledge which students could draw on in relation to an environmental education process within the core.

Such a core curriculum would employ teams of teachers from both arts and sciences, and give them complete control over the process and the organisation of content and time. School hours would have to be allocated for these teams to plan their work and exchange insights. This kind of learning process demands high levels of decision-making and problem-solving skills in teachers, and the free exchange of ideas between teachers would be a prerequisite. An action-research mode of learning in environmental education can only be implemented with students if the teachers are engaged in an action-research mode of teaching. This is something that Posch understood from the beginning of the project, and was the reason for his wanting teachers to generate case studies of implementation problems and issues in classrooms. He has had considerable success with some teachers, and the Austrian case studies document in detail a number of pedagogical problems and issues, e.g. the value of role play, controversies over the learning process which the project generated amongst the school staff and members of the community, student attitudes to knowledge acquisition processes, orga-

nisational constraints on the teaching/learning process, and identifying dynamic qualities.

The allocation of timetabled interdisciplinary project weeks in some countries is a move towards establishing environmental education at the core of the curriculum. But progress can only be made if the following dimensions are seriously addressed at the next phase of the initiative:

- Assessment of dynamic qualities;
- Organisational constraints on developing a learning process defined by the aims, principles and criteria, especially with respect to integrating the arts and sciences;
- Organisation of teachers' time for collaborational planning and reflection;
- Staff development for supporting an action-research pedagogy.

Several case studies illustrated the problems of organising an interdisciplinary process of knowledge acquisition which students could use for problem clarification and resolution. Also Kvarda (1988) recognised:

> *how much time the pupil must be granted to identify targets. In project instruction the way and the aim are inseparable. The problem facing the teacher again and again in project work is that this didactic concept of "letting the pupil find out himself" cannot be imposed on him but should be an implicit part of teaching.*

Such a learning process was successfully realised by some schools, but it has not been incorporated at the core of the school curriculum involving large numbers of students and teachers across all age levels. Several teachers cited problems of integrating knowledge acquisition with knowledge utilisation, which reflected a dichotomy between the passive process of knowledge acquisition and the active processes of experiencing the environment through community action and discussion and media presentations.

A Belgian teacher, for example, suggested that the least popular method of instruction he had employed was digestion of documentation files; an Austrian teacher's students failed to see environmental education as an opportunity for expressing dynamic qualities in the phase designed for a systematic acquisition of knowledge — a phase precisely planned and prepared by the teachers concerned; Maarten Pieters' account of the NME-VO project in the Netherlands, a sophisticated attempt to accommodate a problem-focused interdisciplinary inquiry to the existing curriculum, showed that students in trial schools experienced more knowledge acquisition than action. The Netherlands project, the result of increasing pressure on government by national environmental organisations, was an attempt to lower the threshold of innovation in environmental education to ensure more widespread implementation across relevant subject areas. Prior to NME-VO, two of whose trial schools are operating in the CERI project, the existing conception of environmental education was too foreign, the threshold for implementation too high (see Part Two).

There was considerable disparity between the concept of environmental education which some teachers were advocating and normal practice. It remains to be seen whether the threshold is now too low or, if it is, whether the teaching units enabled schools and teachers to develop beyond it. Have these units gone too far in assimilating the

innovation into existing organisational structures and teaching practices? From the evidence of the case studies, the single most important indicator of whether the threshold of innovation is too low in practice is whether students are bored by the knowledge acquisition process and fail to see its relevance to their actions in the environment. The threshold is too low if students are able to detach knowledge about the environment from personal experience, but are unable to use their knowledge when reflecting on that experience.

One significant outcome of school projects which clearly reflects the five criteria is that they have enhanced students' motivation towards schooling (see, for example, Schlager, 1988*a*). They have transformed the process of knowledge acquisition from one associated with passing examinations in order to secure qualifications, to one which connects with students' personal search for meaning in life. For a few students the project transformed schooling into education but at the margins of the normal curriculum. If this transformation is to be achieved at the core of the curriculum for the majority of students, there will have to be radical changes in the assessment methods used in schools. Until this occurs, highly skilled and innovatory teachers will be ideologically isolated from their peers.

One of the most important appeals the project can make to teachers is that it has been resolving a major problem faced in schools across Europe: student disaffection from schooling, and in particular the low motivation of girls towards science subjects. By integrating scientific knowledge with concrete problems of living in the environment, the project has motivated girls in some schools towards science (see Schweitzer, in Part Two, Chapter XII).

Generally, the case studies and national reports substantiate the initial hypothesis. Those school projects which exemplify the aims, principles and criteria of the initiative appear to occupy a peripheral place in the curriculum. Those which attempt to establish interdisciplinary environmental education within the mainstream curriculum assimilate the innovation in a way which breaks the coherence between its curriculum aims, and distort the first two guiding principles of the project (under Criterion 1), setting them in conflict with principles *iii)* and *iv)*.

We have seen how the interdisciplinary principle is redefined to accommodate existing frameworks and practices. The personal experience criterion (Criterion 5) is also redefined to respect cultural beliefs about the man/environment relationship: the idea of nature study as a curriculum subject.

There is an implicit assumption in some of the school projects, especially in Northern European countries, that seeing the environment as "sphere of personal experience" is a form of nature study which develops an awareness of natural forms, shapes and structures. An appreciation of the intrinsic values in the natural environment is important to develop in education, but it does not constitute a comprehensive concept of environmental awareness.

Such appreciation implies that the environment be experienced as if it existed independently of human agency and technology in a state of nature. It then follows that the only legitimate human response is to protect and preserve its existing forms and shapes, and that environmental awareness has only a protectionist aim. Looking at these pro-

blems becomes largely a matter of instrumental reasoning, of deciding how to preserve existing forms of nature.

The Austrian national report refers to the controversial environmental actions engaged in by some students and teachers who met with opposition from the community. Posch refers to this as a major implementation problem and asks whether at least some of the controversy aroused by certain projects was due to their being perceived as acts of protection and therefore hostile to wealth creation and technological development.

Local projects which interpreted environmental awareness as contemplative experience of natural forms displayed an inconsistent application of the first and third guiding principles. In the contemplative attitude, students do not experience the environment as something they can influence through their own actions. And the learning process does not take on the character of action research, for the outcome of that research is not simply a solution to a technical problem.

The underlying assumption of the nature-study concept of environmental education is questionable. The shapes and forms of nature have not developed independently of the influence of human agency and technology: they are the outcome of innumerable complex interdependencies and interactions between all living things.

The environmental problems and issues which human beings confront may be partly defined in terms of protecting the intrinsic values of existing natural forms. But such problems usually defy simple definitions. In shaping and changing the environment, human beings influence the creation of new forms of nature which manifest new qualities and values. Technological developments can accomplish economic and social purposes while at the same time enhancing the quality of the environment. However, in the designing of such developments, the existing qualities of the environment must be balanced against future possibilities which can be realised through human agency, and both these forms of valuation must be weighed against economic values such as material prosperity and the need to conserve scarce natural resources. Environmental problems also raise questions about the consequences of human agency and technology for the health of human beings.

Environmental problems are not simply technical but imply a complex system of values. Different sets of human values will conflict, and problem solutions will tend to reflect different priorities. As environmental issues confront students with dilemmas between conflicting values, their decisions to take particular courses of action will inevitably be controversial amongst their peers, perhaps with their teachers, and within the school community.

These considerations lead to three further criteria for environmental education implicit in the principles of the project:

Criterion 6: Developing environmental awareness through action research involves coming to understand holistically the value complexity of environmental problems.

Criterion 7: Developing environmental awareness implies a discussion-based process of inquiry which extends beyond the classroom into the community.

Criterion 8: Developing environmental awareness as a pedagogical aim implies that teachers:

- Facilitate a learning process in the form of discussions about the dilemmas students face when deciding on a course of action, and the controversial issues these alternative solutions raise within the community;
- Do not use their position of authority to influence discussions of problems and issues, but adopt a procedurally neutral stance (not to be confused with affective neutrality);
- Protect (rather than promote) the expression and development of diverse views in discussions;
- Accept responsibility for critical standards in discussions, e.g. by requiring arguments to be based on reasons and supporting evidence.

An environmental education process that conformed to these principles would reassure parents and members of the school community, particularly in those countries where citizens value democratic traditions, and would oblige students to take responsibility for deciding on solutions to their problems of living in the environment. The case studies illustrated a number of ways in which school projects enhanced community awareness, since a dialogue between students and community members is a form of mutual education, with teachers becoming both student and community educators.

Community members may well acknowledge the right of students to participate in environmental action, if *a)* they are reassured that their teachers are not using their public authority to manipulate decisions, and *b)* students display a willingness to explain and justify their views and listen to those expressed in different sections of the community. This means that the dialogue would not be confined to classroom situations but would extend into the community. The role of teachers will be publicly visible, which will enable them to demonstrate their ability to facilitate a reflective learning process of discussion-based inquiry into controversial environmental problems, without taking sides.

Many of the case studies provide evidence of a process which conforms to these last three criteria. For example, students in some schools are discussing their analysis of problems and proposals for action at community meetings, and presenting them for public scrutiny and debate through the local newspaper, radio or television (see the Mantova, Italy, case study in Part Two). Community responses to this process have been mainly positive and have usually brought credit to the schools.

The three criteria are implicit in the fourth guiding principle, namely, that the learning process should enable students to "accept the environment as a challenge for initiative, independence and responsible action". Together, these criteria specify important conditions necessary to the development of dynamic human qualities. Their implementation needs more detailed consideration at the next phase of the initiative, especially with respect to Criterion 7. The formulation of this criterion owes much to my experience as a member of the Humanities Curriculum Project under the leadership of Lawrence Stenhouse in the United Kingdom. This project was concerned with helping teachers to handle controversial value issues in classrooms, and it developed pedago-

gical principles governing a worthwhile learning process and an action-research methodology by which teachers could implement them (see Stenhouse *et al.*, 1970 and 1983).

Finally, the CERI project represents a move away from both nature-study and knowledge-acquisition models of environmental education towards a problem-solving model. The next phase should give consideration to integrating aspects of environmental education with technological education at the core of the mainstream curriculum — an issue emphasized in the Norwegian national report. Technological education needs to be set in the context of the environmental problems and issues confronting designers and developers today. Environmental education needs to incorporate technological design activities if strategies for resolving environmental problems are to be comprehensively experienced and reflected upon.

Part Two

CASE STUDIES

I. AUSTRIA: A PRIMARY SCHOOL'S INITIATIVES

Karl Haas,

Headmaster, Thomasroith Primary School

Thomasroith is a village of about 800 inhabitants at the edge of the Hausruck forest in the province of Upper Austria, about 11 kilometers from the district capital, Vöcklabruck. The primary school has only two classes and in 1986/87 was attended by a total of 45 pupils aged six to ten.

As early as more than ten years ago, a group of teachers and pupils started environmental work within the framework of the school. Although it was not taken seriously by many people, the group was able to accomplish considerable positive changes in the village. Their work was limited to isolated initiatives, and the participants were sometimes diffident in their field of action, but their experiences of that period made it easier for the school to participate in the CERI project, which resulted in an intensification and better documentation of our environmental activities.

The main objectives of the work were twofold:

- Promotion of environmental awareness and personal initiatives on the part of the pupils;
- Improvement in the attitudes and behaviour of the pupils' parents and the village population towards the environment.

A great number of activities were undertaken at the school in connection with these objectives. The initiatives fall into four categories:

i) Effecting direct changes in the environment:

- Laying out of a biotope in a private garden;
- Participation in the "Anti-Waste Day" (cleaning the bed of a stream);
- Laying out a flower meadow in front of the school;
- Operation in the school of a container depot for waste recycling (aluminium foil, paper, etc.).

ii) Using personal contacts for influencing the local population:

- "Young Environmentalists on the Go" campaign ("Use Burlap — Not Plastics" questionnaire);
- Flower campaign (distribution of flowers to the local population on the occasion of the International Environmental Protection Day);

— Organisation of a holiday game with environmental activities;
— Organisation of parents' evening meetings on environmental activities.

iii) Exhibitions:

— Construction and operation of an "environmental pillory" in front of the school;
— Design and operation of an environmental display case in the village square;
— Environmental exhibitions at the school.

iv) Informing the local population:

— Design of mail leaflets on environmental subjects;
— Publication of a family recreation guide on environmental protection;
— Publication of a children's daily *(Thomasroith Aktuell);*
— Notes on environmental activities for the local newspaper.

Examples of the work

a) Laying out of a biotope in a private garden

As a result of an initiative completely organised by the pupils, Stefan Redtenbacher, 2nd form, is today able to present to the teachers his self-designed 8m² biotope in the family garden, laid out after a great deal of painstaking detailed work together with two classmates from the beginning of spring. Even the excavation work for the pond was carried out by the pupils alone. Only the sealing foil had been contributed by Stefan's father. As the teachers noticed on their visit, the pond edge had in the meantime also been carefully provided with appropriate grasses and plants. Acting as the guide, Stefan enthusiastically tells us which animals he had successfully transferred to his pond, and which animals had discovered this new living space on their own. Even two water newts Stefan had found in a marshy pool in the forest had made his pond their new home. (School's "Environment Diary", 1 July 1987)

b) "Use Burlap — Not Plastics" questionnaire

By means of a questionnaire developed in class, pupils of the 4th form examined to what extent the local merchants were prepared to offer alternatives to plastic bags. Example of a questionnaire, filled in by a pupil during his conversation with the owner of Karl Kastinger's Bakery:

— *Do you offer plastic bags to your customers?*
— *Yes, we do.*
— *Do you give them away free?*
— *Yes.*
— *What is the most common type of shopping bag your customers bring along?*
— *Shopping baskets, leather bags.*

— *Would you be prepared to offer your customers moderately priced and environmentally sound burlap/cloth bags?*

— *Yes.*

— *Do you think that the local population would readily accept these shopping bags?*

— *Yes.*

— *Thank you for answering our questions!*

All local merchants were basically prepared to offer their customers from then on not only plastic bags but also moderately priced cloth or burlap bags. The pupils then wrote a letter to the editor of the regional paper, requesting local shops for their commitment, and they expanded their inquiry to the district capital Vöcklabruck, which is also a shopping area for many parents.

Within two weeks the pupils had found out which shops in Vöcklabruck already offered their customers environmentally sound shopping bags. The eight shops received a handwritten letter of thanks from the pupils dated March 25, 1987.

For one year our school has been participating in a large OECD environment project. We, the pupils, are now actively involved as keen observers of our local environment. Thus, when shopping, we noticed that your business offers customers not only plastic bags but also cloth or paper bags. We would like to thank you most sincerely for your environmental commitment, and we hope that many other shops will follow your positive example.

The outcome of this campaign was that only one shop responded to the letter by thanking the pupils with a generous parcel of books on the environment. One pastry shop displayed the letter in its window, but the rest did not respond in any noticeable way. In addition:

— Several families now consciously avoid plastic shopping bags;

— In the environment exhibition at the end of the school year a large number of visitors were informed about alternative shopping bags;

— Pupils have been closely observing the shopping behaviour of their teachers;

— During a maths class, 4th form pupils calculated the amount of oil needed for the production of shopping bags given out during a single week-end by one supermarket in Vöcklabruck.

c) "Environmental Pillory"

This idea had its origin in a history class, with the teacher trying to illustrate the meaning of the word "pillory" with the phrase: "Day by day we pillory deplorable environmental conditions, don't we?". The pupils did not consider this to be figurative usage but took it quite literally, and a few days later agreement had been reached on the form and location of an environmental pillory. A wooden rack was to be put up in front of the school to display things the pupils found along the wayside, and drawing the attention of the public with notices.

Reactions of pupils before putting up the pillory:

— *I am curious as to what the adults will say!*
— *We pupils must take good care not to have our own litter on the pillory!*
— *Let us hope it helps to keep the village clean!*
— *Some people will surely shake their heads in disbelief at our pillory!*

Reactions of pupils three weeks later:

— *I have seen adults stopping to have a look at the pillory on their way shopping.*
— *Once grown-ups even started a discussion in front of our pillory.*
— *It hurts adults to see empty packs of cigarettes and beer cans on the pillory.*
— *A neighbour told me: "Such a pillory should be put up in every town!"*
— *An adult told me: "I read about the pillory in the paper. That made me curious, and I went and had a look at it."*

Even the local radio station reported on it:

"Every oak has been an acorn." This can be illustrated by an environmental initiative started by the Thomasroith primary school. Some weeks ago the pupils installed an "environmental pillory" in front of the school building on a well-visible spot. On the pillory the young environmentalists fasten all the "lost property" they find along the wayside — things that would clearly belong to a dustbin. Quite often, now, empty packs of cigarettes and beer cans find their way onto the pillory, and many an adult has been quite embarrassed on his way past it. In any case, the pupils noted with satisfaction that ever since, the pavements of Thomasroith have become considerably less littered. After all, who would like to discover his litter on the pupils' environmental pillory!

d) Design of mail leaflets on environmental matters

This idea was developed by the 4th form who discussed the following considerations:

— Who can usefully be addressed by such mailing campaigns?
— What sort of design will attract appropriate attention in spite of the daily flood of mail?
— What orientation should the leaflets have (information, identification of grievances, instruction, etc.)?
— How to make sure that the copy was actually read and made use of by the local population?

The result of these reflections was to send 310 leaflets four times in the school year to all homes in and around Thomasroith. Each leaflet concentrated on a few environmental issues (e.g. tips for the holidays, advice on the responsible use of detergents in spring cleaning).

Both spontaneous responses and inquiries made by the pupils showed that especially the first series was very well received by the local population:

— *Actually I never read direct mail ads, but I had a very close look at your leaflet.*
— *A very good idea! Will you do more of this kind?*
— *That was something I have never seen before: a leaflet produced by children!*

The first leaflet in this series is reproduced hereafter.

Results of the campaign:

- It succeeded in spreading the word about the environmental display case in the village square;
- An increasing number of inhabitants began to deposit waste products such as aluminium foil and used batteries, for which there is no container in the village, at the depot in the school;
- Some families reacted to the December series of leaflets by keeping wrapping paper from Christmas for re-use, and others even renounced using the traditional bangers and crackers on New Year's Eve;
- The offer in the March issue of free dip-sticks for measuring the pH-value of rain-water from the school was taken up by several inhabitants;
- Recommendations to stop using dangerous sanitary detergents triggered discussions in the village, and attitudes observed ranged from openness to change to severe rejection;
- Many of the 700 visitors at the closing environmental exhibition held at the school said that the leaflets had enabled them to form a clear picture of the pupils' environmental work.

Summary of experience gained

a) Personal initiatives are fostered in a positive atmosphere

On days when work was particularly intense at certain stages of the project, pupils were even more co-operative with one another and showed a high degree of mutual consideration and understanding. They continued to take individual initiatives such as collecting used glass and batteries at week-ends, and some designed small ponds in their gardens;

b) Pupils are seriously concerned about their future and thus easily motivated for environmental activities

Their concern is clearly reflected in the four mail campaigns and in the posters designed for their environmental display. On several occasions, pupils were so disturbed by what they observed in their immediate environment that teachers had to convince them to tone down the wording in their written reports;

c) Appropriate praise constitutes a powerful drive for environmental initiatives

Pupils received particular praise from adults for the idea of an environmental pillory, the laying out of a flower meadow in front of the school and for clearing the walking trails in the Hausruck forest. The older inhabitants particularly appreciated the pupils' work, were not sparing in their praise, and encouraged the pupils to continue with new activities;

Pupils' Information to all homes in and around Thomasroith

An honourable task awaits us pupils in this schoolyear: as the only Austrian primary school we may participate in a large OECD-ENVIRONMENT PROJECT. Of the many activities we are planning to this end, we would like to briefly acquaint you with those, in which we would ask the whole local population to co-operate:

From Tuesday, Nov. 11 until Sunday, Nov. 23,1986 our primary school will accovodate the E N V I R O N M E T A L E X H I B I T I O N of the province of Upper Austria. It will be complemented by a variety of actitivities.
The exhibition will be opened on Nov. 11 by the environmental expert of the provincial government, Hofrat Kriechbaum. We most cordially invite you to take part in this event!

S A V E E N E R G Y A N D V A L U A B L E R E S O U R C E S !

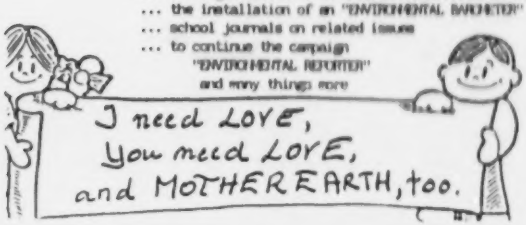
Please do not indiscriminately throw household and kitchen waste into the dust-bin! Many waste products are too toxic (range under 'toxic or hazardous waste') or too valuable (should undergo re-cycling) to end up on a garbage dump.
Besides various containers for waste paper and glass the C O N T A I N E R D E P O T I N T H E P R I M A R Y S C H O O L is at your disposal, where you can also deposit ALUMINIUM FOIL, PLASTIC CUPS and USED BATTERIES.
We will transfer the collected material to appropriate waste disposal and re-cycling plants.
For aged or handicapped persons we will willingly organise a collection service for such materials.- Just give us a call!

N E W : E N V I R O N M E N T A L D I S P L A Y C A S E I N T H E V I L L A G E

Please take note of our ENVIRONMENTAL DISPLAY CASE in the park, which will be operated by the pupils in 1986/7. In it we would like to inform you about our current activities, partial results of projects and at the same time offer incentives for a review of environmental behaviour.

Please help us to keep the hiking trails in our beautiful Haustruck-forest and the recreational facilities in the village free from litter! Again our motto is: "PARTNERS not ADVERSARIES"

Within the framework of the OECD-ENVIRONMENT PROJECT we also plan:
... the organisation of an Environmental Protection Day
... the installation of an "ENVIRONMENTAL BAROMETER"
... school journals on related issues
... to continue the campaign
"ENVIRONMENTAL REPORTER"
and many things more



PLEASE GIVE US YOUR SUPPORT!
THE GIRLS AND BOYS OF THOMASROITH PRIMARY SCHOOL

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BEST COPY AVAILABLE

d) Parents can be motivated to examine environmental problems actively via their children

This experience was impressively confirmed by the regular parents' evening during the project. Further responses by parents were heard at the closing exhibition, such as that adults often live from day to day, unthinkingly, while children reflect much more seriously on ways of mastering the future. From the teachers' perspective, parents' motivation gave rise to a particularly satisfying form of partnership;

e) Weaker pupils have the opportunity of gaining status

— Markus, 3rd form, had fervently been trying to improve his status by clownish behaviour. Through his work in the project, and his high sensitivity to changes in the environment, he had a different role to play and therefore gained considerable status with his classmates. This development was reinforced by appropriate praise from his teachers;
— Mario, 3rd form, had had acute problems within the class community because of his introverted behaviour. A sociogram made at the beginning of the project clearly confirmed this fact. During the project, Mario showed the highest degree of commitment in all environmental activities, thereby gaining the appreciation of teachers and pupils. At the end of the project, demonstrated by a second sociogram, he had made up for lost ground both in class and in the school community;
— Andreas and Stefan, 4th form, attended to the container depot in the school building with a great deal of circumspection during the project and thus, in spite of weaker overall performance in class, considerably gained status within their class. Both pupils also showed significant improvements in independent activities;

f) The media take pupils' environmental initiatives seriously

— The communal paper reported on the project in two issues;
— The regional paper Vöcklabrucker Wochenspiegel published several articles during the project and a summary at its conclusion;
— Radio Upper Austria broadcast three features on the project.

II. BELGIUM: ENVIRONMENTAL STUDY OF THE MEUSE REGION

Arthur Barzeele,

Koninklijk Atheneum, Maasmechelen

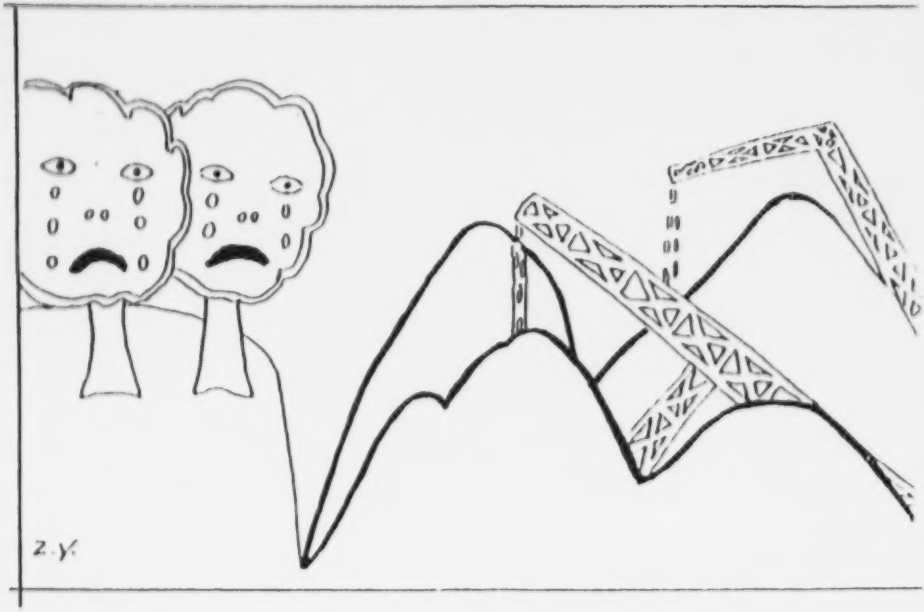
Towards the end of September 1987, F. van Esch, state school biology inspector, and Dirk Coolsaet, national co-ordinator, invited our school to participate in the OECD project to optimise the relationship between schools and the environment and thus make it a real-life instead of theoretical subject. Such participation was to be confined to a single school class which would design its own activity outside the everyday academic framework but remain in the locality of the school.

Originally, our intention had been to cultivate a small barren area inside the school walls; later, however, a local environmental issue was chosen which would have a broader impact on the population: a gravel excavation in the Meuse valley. Over the centuries, the river had deposited thick layers of gravel which were now being intensively exploited and causing many environmental problems. This issue turned out to be part of a larger problem, and the project therefore ended in a full-scale environment study of the Meuse region, an area of five municipalities and around 100 000 inhabitants.

We opted for a practical, critical and creative approach to the subject, using different methods of instruction. We aimed at integrating knowledge into attitudes by means of skills, in order to contribute to the students' personality formation in the service of the community. While conducting the project, we assumed that education as a whole would be promoted by a direct confrontation with reality and thereby be experienced in a broader and more intensive way. A sense of initiative, self-discipline, team work, open dialogue and co-responsibility all came into relief. Throughout the initiative we had a spacious classroom at our disposal, so that all "home" activities could be centralised. The students were split into five groups. Each group was given a share of data collecting and processing whereby practice and theory alternated. The teachers who supervised the groups were given a written briefing about the activity beforehand. Teachers played a passive role in most activities: they only appeared or made small corrections when necessary. This forced students to take initiatives and bear responsibility.

Activities during the project week included excursions, interviews, research and processing of data (geology, hydrology, biology, history, population, employment, unemployment, traffic, tourism, plans for the future, etc.). The variety of subjects and

the different methods of instruction ensured undivided attention and involvement. A good work climate, a sense of creativity and originality, motivation and perseverance contributed to the success of the project.



A cartoon contest produced about 40 cartoons, three of which were selected and printed as colour postcards and over 2 500 of them sold. There were several newspaper reports to introduce and illustrate our project, as well as three radio interviews and three students' participation in a young people's television programme. The project was rounded off in the local arts centre theatre with a mime by the students and a debate with politicians, gravel pit owners and specialists on regional environmental problems.

The particular proposal to convert a former gravel pit into a sports and recreation ground was a very sensitive issue, since this land had been designated as farmland. We thought it would be interesting to start with a theatrical presentation of the issue just before the debate took place, and 56 students participated in a mime presentation. They symbolised the plants and animals in an area threatened by gravel exploitation. Two rabbits, newly fallen in love with each other, formed the thread running through the story, so that spectators gradually became involved in what was happening on the stage. Consternation was great when a brute excavator suddenly disturbed the peace and quiet and destroyed the area. The rabbits, flora and fauna had to give way to a highly controversial water-ski project.

The mime appeared to be the ideal introduction to the debate, as it gave a vivid illustration of the issues: attitudes towards exploitation, conservation of nature, employment, perspectives for the future, and so on. This resulted in a serious discussion, and the audience addressed difficult questions to the responsible politicians.

III. DENMARK: HOW DO WE WANT TO USE NATURE?

Per Buskov,

Braendgardskolen, Herning

The objectives

As outlined in the general principles of the Danish *Folkeskole*, one of the purposes of education, and consequently of environmental education, is to train pupils for participation in decision-making in a democratic society. In order to live up to these objectives, environmental education must follow three aims:

i) Understand that the relationship between nature and society is not preordained, that the destiny of nature is determined by the way society administers it. Problems found in the environment are direct or indirect consequences of decisions made in society. Pupils should understand that questionable conditions can be changed — if we so wish.

Thus, the Godstrup Lake Project aims to generate the understanding that the condition of the lake is a consequence of reflections and decisions, and that we, the adults and children in Herning, are the ones to determine its future.

ii) Pupils should not only obtain knowledge of the actual facts but also of the possibility of expressing ideas, wishes and utopian suggestions. They should know that these are being discussed and may be changed on the basis of accessible knowledge, esthetic and ethical conceptions, and social reality. Utopian ideas are essential, not for the new conditions we want to create immediately, but as long-term aims and as they influence our thoughts and actions here and now.

Through direct research the pupils will obtain knowledge of the state of the lake and the background to its condition. Pupils will have the possibility to express their ideas and wishes as to the condition and function of the lake.

iii) Pupils should acquaint themselves with their possibilities and limits to influence democratic decision-making, and test feasible democratic actions themselves.

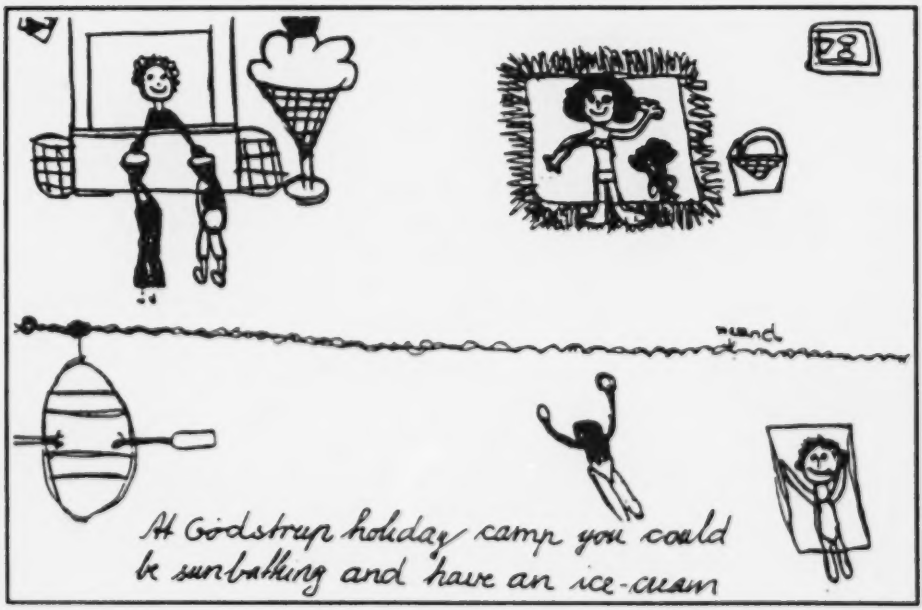
Discussion of utopian ideas as opposed to actual conditions and immédiate possibilities is central to these aims. A product that will carry points of view and suggestions beyond the classroom is also important, whether this takes the form of a presentation of

the project to another school class, a direct inquiry to politicians, or participation in a public debate on the local radio or in the local paper. Pupils will choose among the various possibilities the way in which they want to publish their product. They will try to influence and convince others through a dialogue and at the same time see their own views modified and elaborated.

The project

Participants in the project were ten girls and eight boys from grade 5 in a provincial school, the teacher responsible for environmental education, and a part-time assistant teacher. By combining lessons of various subjects (Danish, history, geography and creative art), six environmental education lessons could be given in one week. The project lasted for six weeks and included two excursions of five lessons each.

The subject, "How do we want to use nature?", was chosen by the teacher, and Godstrup Lake was selected as an example. The lake covers about 50 hectares and is located 4 kilometres north of Herning. A stream, Herningholm, running through the lake, has for years received waste water from the central purifying plant, including sixty tons of phosphorus annually. In practice the lake has been used as a precipitation basin for the sludge of the waste water, and the lake is therefore heavily polluted and characterised by algal bloom followed by deoxygenation and yearly releases of hydrogen sulphide.



In planning the course, the teacher laid down the main outlines of the project and made a provisional choice of teaching materials and line of procedure. He divided the project into three phases: experience, investigation, and action and discussion. The preliminary phase of experience was planned by the teacher alone but, thereafter, the pupils' experiences and observations from their first excursions were taken into account when organising the subsequent phases of action.

The phase of experience

A day excursion to Godstrup Lake initiated the course, and the following observations were made:

- The water running into the lake seemed very polluted;
- There were hardly any plants in the lake, but at one spot there were so many filamentous algae that they covered the water like a blanket;
- If you walked into the lake and stamped the bottom vigorously, a lot of bubbles rose from the bottom;
- There was an enormous amount of daphnia in the water close to the edge;
- There was a lot of plastic and other waste along the edge;
- The water running out of the lake was clear and there were a lot of aquatic plants at the bottom;
- A man setting traps for eels at the mouth of the stream described how the lake was almost emptied of fish nowadays, whereas formerly a lot of eel had been caught there.

The phase of investigation

The teacher and pupils produced a list of things to explore:

i) How Godstrup Lake was created;
ii) The quality of the water, and the life of plants and animals in the inlet and outlet of the stream, and in the lake itself, in order to get an idea of the pollution;
iii) What it was like at Godstrup Lake in the old days.

The results of our examinations were to be documented on posters, which we would then use in our presentation of the project.

i) How Godstrup Lake was created

A local natural-history description of the lake was valuable in examining the theory that the origin of the lake was a kettle-hole (left by dead ice from the last glacial age) caused either by a thrust of the ice cap during a temporary cold spell or by the main stationary line being further west than originally supposed. The doubt concerning the origin of the lake provided us with the opportunity to illustrate to the pupils that scientific theories were not necessarily final truths but assumptions which might be changed in the process of acquiring new knowledge.

ii) The quality of the water

A second excursion was spent doing biological investigations at the lake. The class was divided into three groups who carried out identical tests and subsequently compared results. The material collected from the stream at the inlet and outlet, and from the lake itself, was studied and classified in the classroom, and the biology of a few of the dominating species studied more thoroughly: algae, daphnia, midge, etc. According to the saprobic classification table, the water at the inlet was estimated to be two, and the water at the outlet to be seven on a scale of ten (ten indicating unpolluted water). To illustrate the decomposition of organic material at the bottom of the lake, which, among other things, results in production of methane, we built a model which produced methane from plants such as grass, potatoes, etc. The gas was burnt in a darkroom.

We discussed possible causes of our results by seeking answers to the questions: Why does the water in the inlet smell bad? Why are there many germs in the water in the inlet? Why are there many midge larvae in the water in the inlet? In this way the following aspects were theoretically examined:

— The significance of the introduction of nutrient salts into streams and lakes (algal bloom resulting in deoxygenation);
— The connection between the introduction of nutrient salts, heavy algal bloom, many daphnia and water boatmen at the edge of the lake;
— The significance of the introduction of mud in the lake;
— The effect of the lake as a purifying plant, depositing mud and nutrient salts.

We concluded that the town of Herning pipes polluted water into Godstrup Lake through Herningholm Stream. The lake functions as a purifying plant and is filled up with mud because the water running out of the lake is much cleaner than the water running into the lake.

iii) What it was like at Godstrup Lake in the old days

A group of pupils and a teacher went through the archives of local history at the Herning library and collected historical information about the lake. Old photographs were copied and relevant texts examined, such as a report from the vicarage of Godstrup dated 1766.

The group discovered:

— Where the name of the lake derived from;
— That there had been more water in the streams leading into the lake and that the Vikings had been able to sail into the lake;
— That there had been a lot of eel fishing in the lake;
— That Godstrup Lake used to be a popular place for picnics;
— That there are many legends connected with the lake.

The group produced a poster with texts, drawings and photos and presented the result to the rest of the class. One interesting finding was an old legend about how the plague flew to Godstrup and covered the lake with a blue apron, and how animals and humans fell ill when drinking from the water.

The disease of the water has not disappeared completely. Even today the lake turns blue on hot days, and if the cattle drink from the water when it's blue they will die.

We reached the conclusion that algal bloom and temporary deoxygenation were not only contemporary phenomena, since their occurrence, even before the lake was polluted by waste water from the town, might have been caused by a release of nutrient salts from the deposit of organic material in the greyish green silt found during geological investigations in 1947. However, it was clear to us that the lake had been used in the past for various important purposes which were no longer possible, considering its present condition.

The phase of action and discussion

Three courses of action were decided upon:

i) We would produce suggestions for the future use of Godstrup Lake;
ii) We would present our results to another class;
iii) We would write to the local authority and ask them to answer our questions orally or in writing.

Our suggestions for the future use of the lake included proposals that the lake and the area around it could either be made into a holiday and bathing resort or into a nature reserve. A precondition of the implementation of the two suggestions was that the lake be cleaned. The pupils discussed the advantages and disadvantages, financial matters, etc., of implementing these ideas.

In a subsequent discussion, the proposals were rejected. According to the class, the idea of continuing to use the lake as a purifier and a precipitation basin was out of the question. Even though it would be costly, the waste water was to be cleaned before it left the purifying plant, and the precipitation was to be removed from the lake.

The idea of building a holiday and bathing resort seemed more attractive to many pupils. It would probably be expensive to build, but it would create opportunities for making a profit later on. Yet this proposal was rejected. Even if the lake was cleaned, old reports showed that the possibility of heavy algal bloom and release of hydrogen sulphide still existed. And if that occurred, the whole project would be bankrupt. People, traffic and noise in the area would create problems as well, and wildlife would be frightened away.

The suggestion to make the area a nature reserve seemed a pleasant thought to many of the pupils, but it was discussed whether the area was suitable for that purpose. Wide areas of agricultural land would have to be bought and turned over to the reserve. It would be very expensive and there were no possibilities of making any profit. Moreover, it was questioned as to whether there was anything particular or exciting in the area to justify it being turned into a nature reserve. So this proposal was also rejected.

Although none of the suggestions were entirely satisfactory to the class, most pupils had taken a firm standpoint as to the future of the lake: its pollution had to be stopped and the mire at the bottom removed. When the lake had regained its natural condition it could be used for swimming and sailing. Fishing would be permitted and trout

released in the lake. The local authority might build a nature school in the area, and the old cottages nearby could once again be a place for holiday excursions.

Another group of pupils wrote a letter to the local authority and to the members of the City Council, who were also members of the Committee of Technique and Environment:

> *We are a grade 5 class at Braendgardskolen who have worked on Godstrup Lake and would like to talk to you about the condition of the lake. We have been out there twice and carried out various investigations. We took some samples and found that there were more germs in the inlet than in the outlet of the lake. In the inlet we found only midge larvae and no other aquatic animals because they cannot live in the polluted water, and there were no aquatic plants either because there is no light at the bottom.*
>
> *The water smells very bad and rotten. We took some water from the inlet and the outlet and poured it into jars to measure the amount of sediment. In the inlet sample there were about 3 cubic centimetres of sediment per litre; in the outlet jar there was no sediment and the water was quite clear. We have found that Godstrup Lake is like a purifying plant when Herning discharges waste water and that the lake is being filled up with mud.*
>
> *Is the lake still to be used to clean the waste water or will that be changed? We would be very pleased if you would answer this question and tell us what you have in mind, either by letter although we would prefer it if one of you could come to the school and tell us about the plans for Godstrup Lake.*
>
> *We have a few suggestions ourselves which we would like to tell you about.*

The presentation of the project to another class was postponed until we had received an answer from the local authority. Some of the pupils had, of their own accord, started to sketch the lake as it might have appeared in the age of the Vikings and during the plague in the 17th century. A consequence of this was that the whole class agreed to make a creative-art excursion to the lake.

Evaluation

At the start of the project, most pupils knew that Godstrup Lake was polluted but only a few had ever been there, in spite of the lake being located near Herning. At the end of the project, the class had found it a pleasant place to go to, although their investigations had confirmed that the lake was polluted. The creative-art excursion was an unplanned derivation of the project. We feel that to express personal feelings one may have about a lake, and to describe it by way of creative art, is as important as writing a report on biological examinations.

The class has enjoyed the programme in environmental studies, particularly the excursions, the studying of wildlife, the history of the Vikings, and the writing of letters to the authorities. We still do not know whether we have generated a dialogue with the local politicians. Yet even if we do not receive a reply to our letter, the mere process of writing is an important experience in itself, which ought not to lead to the view that "they are the ones to make decisions, and it makes no difference what I do", but is an experience which we can use productively in future school work.

IV. FEDERAL REPUBLIC OF GERMANY: FOUNDING A NATURE CENTRE

Walter Fiedler,
Realschule Bredstedt
(in co-operation with *Günter Eulefeld*)

Our school is of medium size with about 400 pupils and is situated in a sparsely settled (80 inhabitants per km2) northern part of Germany. We do not have much industry but intensively used farmland, with some open lots for natural sites. Because of its proximity to the North Sea, the area is particularly attractive to tourists, and although this does create employment it sometimes also turns out to be an environment problem. In the vicinity of the school there are enough biotopes for field studies in biology instruction, with wayside groups of bushes, ditches, ponds, forests and moors nearby. In our area, therefore, environmental education has the special task of co-operation with tourists who need — and are very often interested in — information about nature, pollution and nature protection.

In 1975 the nature protection group in our school was given an 80 year-old schoolhouse for its activities. This group consists of a varying number of pupils: during the first years they were as many as 90, later there were between 20 and 40. The age range is between 13 and 14.

We first had to rebuild the dilapidated schoolhouse. We then began to gather nature objects from the area and equipped the 30 rooms of the large old house with dioramas showing natural sites with plants and animals. Small groups of three pupils were responsible for the different rooms, but decisions concerning the nature centre itself were taken by all groups when financial, organisational, technical and discipline problems had to be solved. Pupils had their own particular tasks, some preferring to take photographs and therefore belonging to the documentation group. Others looked for tools, paints, wood and other materials for the construction group. It took the pupils three months of work and 400 kg of paint to renovate the structure. In order to prepare the information plates they had to study biology as well as problems of nature protection. Both manual and cognitive endeavours, therefore, had to be integrated.

One year later we were able to open the new nature centre. The pupils guided the visitors and explained the ecosystems demonstrated by the dioramas. They also offered tourist excursions in the open air within the respective nature areas. Additionally, the pupils worked in a protected area on a nearby moor site where they learned how to pre-

serve such nature areas. On one occasion two boys guided an old man among the dioramas, one of which contained a stuffed dolphin. The visitor — himself a conservationist at a university — was so impressed by the boys' work that he offered them two seals as a gift for their exhibition. There are now also four stuffed storks in the nature centre, having been found dead under transmission lines. They had brown bills and legs, as all young storks have, which astonished most of the visitors. They asked why the birds did not have red bills, and a debate ensued among the pupils as to whether to paint the bills and legs red.

In the meantime the centre has grown rapidly. The number of visitors rose from 5 000 in 1976 to more than 27 000 in 1987. It was therefore no longer possible to run the institution by pupils alone, and the town took over the financing of a permanent job at the centre and offered temporary jobs to those who otherwise would be unemployed. In the last few years the pupils and adults have been expanding their work in the field of nature and environment protection, and a large part of their time is used for preparing instructional material for teachers and pupils of other schools to assist them in conducting field work. Five hundred teachers and 3 000 pupils used this material in 1987.

V. FINLAND: THE ART DAY

Arja Kujansuu,

Länsi-Pori Upper Comprehensive
and Upper Secondary School

Our school is a fairly new complex with 800 students. It was founded in 1965 and its present building dates from 1972. The surrounding population lives mainly in detached houses. The upper secondary school emphasizes the arts, so that students can include more art instruction in their study programme than in an ordinary school.

The school organised its first art day as early as 1984. One of several themes was that of the environment. The project was carried out in the upper comprehensive school on November 27, 1986 and in the upper secondary school on November 27, 1987. About 450 upper comprehensive school pupils and 250 upper secondary school students participated. In both projects, students were permitted to form groups on their own according to set topics and within a framework of working themes. The instructors of the various groups were teachers of different school subjects, as well as artists living in the neighbourhood.

In the upper level of the comprehensive school the themes were divided according to grade level. In grade 7 (13 year-olds) the theme was "Life sprouts from the roots of the land"; in grade 8 (14 year-olds) "From a tree to a park"; and in grade 9 (15 year-olds) "Towards a comfortable environment". The groups had a variety of materials and working methods at their disposal, and the purpose was to familiarise pupils with the various art techniques.

The themes in the upper secondary school were partly the same as in the upper level of the comprehensive school. Separate groups were formed for those interested in working with pastel colours, and they produced paintings on sensitive, emotional poems; the acrylic painting group considered city rhythms and made paintings of them; the opaque paint group created "Parks we dream of", and the water-colour group created paintings on the cultural scenery of the city of Pori. Another group was involved in planning wall paintings and papers with a computer. Still another group made large-surface works with painted strips of wood and cardboard.

Work at the upper level of the comprehensive school yielded, among other things, curtain designs with stylised blue tits (*Parus caeruleus*, the emblem bird of the school district). Using clay, the pupils designed human heads representing the different elements: earth, water, air and fire. One group planned sketches for a mural on the gable

wall of an apartment building in the centre of Pori. In graphics, the pupils made drawings on historico-cultural buildings in Pori. One group planned a park with plants and constructions in an empty lot close to the school. All the groups met with an artist involved in their work and were thus given an opportunity to see a real artist at work and ask him about the various aspects of it.

From the point of view of environmental study, the most interesting theme was perhaps "An alternative to plastic bags", where the upper secondary school students, during ordinary art lessons, planned drawings and water colours on paper bags. The bags were then taken to the city library to be sold there. This event was called "An alternative for plastic bags" and was thought necessary to break with a Finnish tradition. Similarly, 9th graders of the comprehensive school designed pictures with environmental themes on mail envelopes used in the office of the city of Pori.

The results of the project were exhibited in the assembly hall of the school. The exhibition was open to all students, parents and the general public. Later, the exhibits were shown in the city library for a couple of weeks. Local newspapers were invited to an information meeting during which representatives of the Ministry of Environment, the National Board of General Education and the city of Pori familiarised themselves with the project.

The results of the art days have been considerable:

Numerous forms of artwork have been created through different techniques. The participation of outside artists has increased the sense of reality in the students' work, and the attention paid by the press has improved their self-assurance. The city library of Pori has purchased the paper bags (over 100) designed by the students. The majority of city employees agree on the successful design of the office envelopes. Students took an active part in something which differed positively from ordinary school work, and parents had an opportunity to become familiar with an unusual outcome of education.

VI. ITALY: THE WATER ANALYSIS PROJECT (WAP) AN ALTERNATIVE MODEL FOR ENVIRONMENTAL STUDY

Sandro Sutti,
Istituto Tecnico Industriale Fermi, Mantova

The schools and their environment

Our study took place in Mantova, in an area which in the past 30 years has seen profound socio-economic changes: the reorganisation of farm work linked to progress in technology and science, economic growth, automation and computerisation in livestock raising, the great expansion of the service sectors, the increasing success of industrial sectors such as petro-chemistry, refineries, paper processing, metal, and clothing.

Water resources pay the bill for this progress. In the 1970s, the industries located at the lakes around Mantova caused extensive pollution. Though in recent years industrial pollution itself could be significantly reduced, a veritable scourge of grave proportions has broken out owing to pig raising and the various incidents of pollution of ground water from trichloroethylene, nitrates and atrazine, which has brought to public attention the fact that the problem is much more complex than it was previously thought to be. The situation is all the more grave considering the fact that three natural rivers flow through the province of Mantova — the Po, the Oglio, and the Mincio which feeds the lakes of Mantova. There are also hundreds of man-made canals constructed during the first half of this century, making Mantova one of the most water-abundant provinces in Italy.

Furthermore, the history of Mantova is closely tied to the use of its waterways: from the times of Etruscans who used the Po to transport their goods, to the Gonzaga era and up to the end of the 19th century when this belt of lakes formed a natural barrier against aggressors. In present times, these waterways play an important role in recreational, agricultural and industrial activities.

It was only logical, then, that an environmental study would take water resources as its subject. Since 1981, five schools have been conducting an annual interdisciplinary study of the surface and ground waters in the province of Mantova: the Water Analysis Project (WAP). These studies are commissioned by communities requesting a precise diagnosis of the aquatic system, of changes over time, and proposals to improve its quality.

The schools involved are:

— Istituto Tecnico Industriale E. Fermi (ITIS) — a technical industrial school (15-19 year-old students);

— Istituto Magistrale I. d'Este — a school for the education of primary school teachers (15-18 years);
— Istituto Professionale Femminile Don Mazzolari (IPF) — a vocational school for girls (15-19 years);
— Istituto Tecnico Femminile A. Mantegna (ITF) — a technical school for girls (15-19 years);
— Istituto Statale d'Arte — State Art School (15-19 years).

Description of the study

The study, of which the culminating moment is the execution of a cycle of chemical, bacteriological and microplankton analyses, proceeds through the following stages:

i) Preliminary contacts and agreement between school and local board;
ii) Study of the subterranean and surface hydrography;
iii) Territorial survey;
iv) Location of the sampling sites and sampling plan preparation;
v) Training and practice in water sampling, analysis, gathering and re-elaboration of the data;
vi) Setting up of the operative base;
vii) Analysis cycle;
viii) Re-elaboration of data;
ix) Publication of the results.

i) Preliminary contacts follow up written requests sent by the municipal administration to the school; they serve to identify the scope and aims of the work, the necessary facilities and services (meeting rooms, canteens, transportation, etc.). The school later presents a budget based on previous experience and the availability of services offered by the local boards, to the local administration;

ii) For the study of the hydrography of surface water, information is furnished by the land reclaim authorities, the civil engineering corps and the rain gauge station concerning the seasonal conditions of water flow and the level of the drainage and irrigation canals. The ground water survey requires precise indications of the direction of deep currents, and students therefore take advantage of advice from two expert hydrogeologists;

iii) The territory was divided into 10-12 zones of 3 to 5 km^2. Each zone was assigned to three to five students who surveyed it to register possible sources of pollution, dumpings, and wells for drinking and irrigation water;

iv) On the basis of the indications gathered during the field inspection, a map of water sampling sites and a sampling plan were prepared;

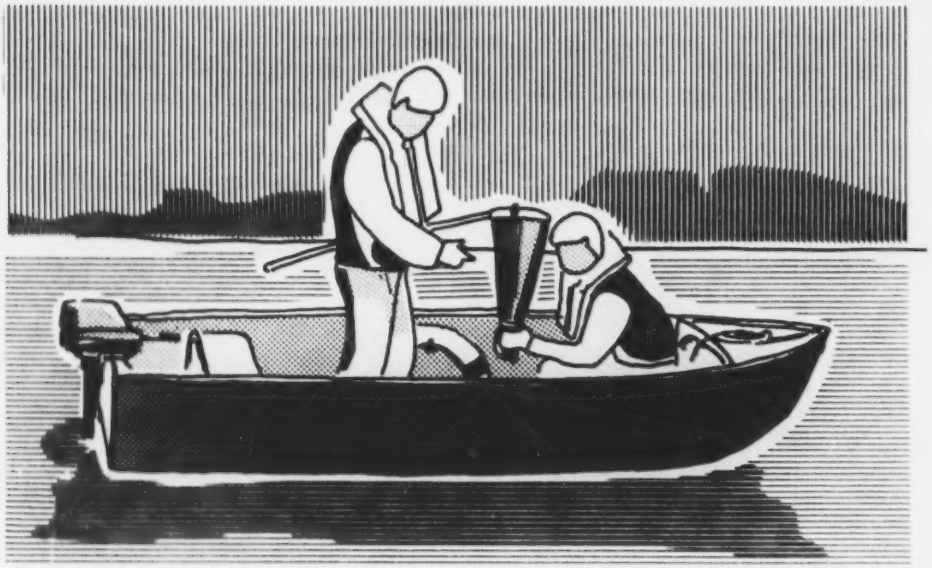
v) To achieve precision and speed, all the students undergo intensive training in water sampling (three motorised sampling teams of two students each) and in analysis work in the various laboratories;

vi) Much energy is necessary to train the data centre team of five students and two teachers, the focal point of the organisation, that co-ordinates the various units and collects analysis data;

vii) Among the chemical laboratories is the mobile one, set up in the territory during the analysis cycle;

viii) After the analysis cycle, generally accomplished in springtime, the data-processing phase begins and the results of the chemical, bacteriological and microplankton analyses are compared;

ix) The work is concluded in a public lecture with a presentation of the results to the local administration, and coverage is given by radio, television and the press.



If the various segments of activity are examined *prima facie*, then without doubt that of the laboratory is the dominant one. If, however, segments are measured with reference to educational objectives, then the role that problem-solving, individual and group research, and social activities play in the assignments must be emphasized. Students have to interview external collaborators; organise territorial surveys; follow through, register, select, mark and evaluate effects; draw up work plans, follow schedules; register, control, sample; make reports; present data previously processed; transport, drive cars; and know how to swim!

For each analysis cycle, 13 teachers and 20 classes with 300-350 students are involved. In one day, they can gather and examine 45-60 samples for chemical analysis, 20 for bacteriological analysis, and 15 for microplankton analysis. Of the 1 500 presumed polluting sources in the province of Mantova registered as of 1972, 900 are well

suited for sampling. The students would therefore be able to analyse the most significant wastes in the entire province within 15-20 days for chemical analysis, and within 45 days for microplankton. With few exceptions, all the work was done within normal school hours.

Phases of the study

For the participating schools, the annual study carries many meanings. WAP served to break down the isolation of each school, form a dynamic link with the real world surrounding it, and stimulate its receptiveness to evolving phenomena. After the WAP experience, a static and rigid school structure appears anachronistic. With WAP, the school furnishes a concrete product without compromising its institutional task, educational objectives still holding pre-eminent positions in the list of WAP aims.

One particular aim of the study was the development of the dynamic qualities of the teachers, students and technical assistants involved. Students had to assume responsibilities and autonomy in preparing and accomplishing their tasks. They often had to make rapid choices and were forced to rely on their decision-making abilities, for example when they had to select a source of pollution, set up a territorial survey, or choose the range of optimal concentration for the analysis of a parameter.

The work brought those involved into social contact with people not usually encountered in a traditional scholastic context. Representatives from the local boards met with the students to convey the expectations of the administration. There were also meetings with environmental protection groups and other associations directly or indirectly involved, such as fishing clubs. During the territorial phase, door-to-door surveys to register sources of drinking and irrigation water enabled students to come into contact with the local population; likewise, when the townspeople brought water samples to be analysed, or when classes visited laboratories. Furthermore, the presentation of the results of the study generated debates, at times very heated, between the project participants, the administrators and the public. These were occasions when speaking in public was practised and self-confidence developed.

Another aim was to bring out the aptitudes of the individual students: all the charts, graphs, tables and a large part of the maps were drawn by the students who felt the desire to make a personal mark on the study. It is usual practice to leave to one group of students the drafting of the control routine of the analysis data, and to another group the organisation and transfer of the resulting data to the computer for statistical procedures.

A further aim was to draw out and improve students' critical skills, urging them to propose variations or changes to the model in the interest of improving it. The students should also feel in control of the study, intervening at any stage during the organisational preparations of the work. They should thereby feel a sense of ownership of the whole structure, as this is considered a necessary precondition to the initiation of teamwork, which requires respect for the procedures laid down by the organising committee. They should, moreover, accept that difficult tasks were to be accomplished, and that particular skills such as precision, accuracy, quickness and clarity were to be acquired.

In a traditional school, non-participation in scholastic activities decreases the learning performance of the individual student but has no bearing on the rest of the class. In organised work, however, carelessness "reverberates" among other participants, owing to the interrelated character of the tasks, and there is prompt social pressure to any disturbance in order to re-establish an equilibrium in the carrying out of the work. Another characteristic of team-work is that everything must be planned with the awareness that whatever has been imposed on a theoretical basis can in practice be improved by the introduction of corrective coefficients. The acquisition of rigorous methodologies of programming constitutes, thus, another essential objective of the model.

The WAP provided students with their first serious confrontation with their surroundings. Our study served to impress upon them the thoughtless, careless and at times abusive manner with which the environment was treated. It also served to stir up feelings of incredulity and anger, to start discussions on the causes of these phenomena and their possible consequences, to channel the energies of protest into positive and constructive forms, and finally to help them acquire a true appreciation and awareness of the environment.

This was true for the teachers also. There were, however, specific objectives for the participating teachers. They wanted to expand their own abilities to plan, organise, manage groups, work out models and try them out in the field; widen and deepen their knowledge in their own field and expand it in interdisciplinary discussions with teachers from other schools. They could also hope to be able to make a "holographic" evaluation of a student: being able to take advantage of wider limits to liberty than those in a traditional school, students offer different elements for judgement.

The teachers' role changes according to the phases of the study. In the early stages they must be able to create the right spirit in the class: they must act as catalysts and help accelerate the dedication of the student to his work. Later, the teachers' role is one of supervisor and co-ordinator. They are no longer the principal protagonist in the teaching situation, but still assume a position strategic to the success of the work.

Results and effects

In the panorama of results, those which can be evaluated with the greatest precision must be distinguished from those connected with the maturation process of the students. Among the objective results are the tens of thousands of analytic data gathered over a ten-year period. Every five years an exhibit summarises the work of past years. Many reports have ensued from the examination of the results, including publications financed by various administrative bodies six to twelve months after presentation of the results. The project has furthermore produced a considerable amount of documents, maps, charts, graphs, demonstrative materials such as photographs, slides, Super-8 films and video cassettes. Visual materials were produced by students of the State Art School, who were also responsible for static iconographic materials (posters, brochures, etc.) and for supervision of all the audiovisual material of WAP. During the first few years in particular, frequent use was made of the mass media.

Among the list of concrete accomplishments, the following materials constructed by the students and teachers of the Mechanics Course of ITIS can be mentioned: containers for microplankton and racks for transporting them, disks for measuring transparency, protective cages for thermometers, protective covering for probes for measuring dissolved oxygen in water, diverse types of sampling equipment for deep and surface water, etc.

Other results and effects of the WAP structure, some of which are difficult to quantify, have had profound consequences: the circulation of new ideas and the spirit of collaboration among the various schools, and the professional growth and prestige acquired by teachers in terms of environmental knowledge. Furthermore, WAP has become a reference point for many who deal with environmental concerns: middle schools in the province asking for consultation about specific problems, and upper schools from all over Italy wishing to explore the possibility of applying WAP to their social realities; public administrators interested in water monitoring; and ecological groups needing scientific data to support environmental disputes.

But the schools involved in WAP are not only "service agencies"; they often obtain valuable attitudinal results, especially the removal of certain mental obstacles for a student's deeper awareness of his power of changing things around him. Another result we are proud of is our involving of the local population in environmental reflection:

- Before the students go out into the field, the mayor makes a public announcement stating the aims and time schedule of the research, and inviting citizens to assist the students. Many reports of actual or presumed pollution sources are thus made known to the students;
- During days when analyses are performed, townspeople and especially students are invited to visit the mobile laboratory and the data centre where they are guided by students specifically trained for this task, and can gain a good impression of the study by looking at the charts, maps and other illustrative materials;
- The public are encouraged to bring water samples to the mobile laboratory for potability tests;
- The presentation of the results is a key moment because it offers an opportunity for citizens to find out more about their surroundings. For this reason, the meeting is carefully prepared with due attention to the local media, who then give ample coverage to the event, the debates and the findings.

We would like to conclude with a few brief episodes from a very wide field of activity:

In San Giorgio in 1984, during the territorial survey, a group was invited by a hospitable farming couple to a hearty repast with local salami and wine.

During a visit by a class of a local middle school to the mobile laboratory, one of the responsible students discoursed on the leading role of the students in the study, going so far as to say that the teachers stood around with their hands in their pockets!

During a territorial survey in Curtatone a girl student entrusted with registering wells returned to the operative base in anger because an elderly man had refused to open his door and had shouted to her that women had better stay at home and not go around wasting time! The student returned to the man's door with a local policeman at her side, took her survey, and triumphantly announced her accomplished feat to a roar of applause!

VII. THE NETHERLANDS: ENVIRONMENTAL EDUCATION IN REGULAR SUBJECTS: INNOVATION THROUGH A CURRICULUM DEVELOPMENT PROJECT

Maarten Pieters,
University of Utrecht

Although the Netherlands may have the name of a clean country, there has been growing concern in the last twenty years for the ecological quality of this small part of the world and for the earth as a whole. This concern is expressed in an increasing number of private environmental organisations, among which are several institutions involved in environmental education. From the beginning, one important target these institutions try to reach has been the regular educational system, the schools. Their idealistic ideas were recognised by the schools but that did not lead to a widespread use of the materials offered. The environmental education organisations decided to initiate co-operation with institutions experienced in curriculum development, and three governmental departments were interested in financing a common project.

Since January 1986, the Environmental Education in Secondary Schools project (NME-VO) has been developing an environmental education curriculum that meets the desires and habits of regular school education as much as possible, without violating the basic knowledge and skills that characterise environmental education. The project is restricted to the first three years of secondary education (12-15 year-olds) and to the school subjects of geography, biology, physics and chemistry. It was initiated with the purpose of lowering the threshold for the implementation of environmental education in schools. Since August 1989, the activities have been extended to primary education, and to the subjects of technical education, economy and history in secondary education.

Tasks of the project

The conception of environmental education was obviously too foreign, the threshold for implementation too high. Apart from that, there was too little agreement upon the contents of environmental education. There was also considerable controversy over the character of environmental education, since in Dutch the compromise term natuur-en-milieu-educatie stands for a combination of "natural conservation education" and a more socially oriented "environmental problems education". The following project tasks resulted from those considerations:

— Development of a core curriculum for environmental education, based on generally agreed starting points;
— Development of teaching units;
— Description of alternative school curricula for environmental education;
— Research, part of which concerns the effectiveness of the developed materials;
— Preparation of guided implementation for regular schools.

The tasks were performed in co-operation with eight schools, from different categories of education. The schools tried out teaching units, described the way they integrated environmental education into their curricula, and commented on curricular designs. The importance of school planning, curriculum development and teacher training thus emerged from the evaluation of the schools' experiences.

Since we cannot yet present systematic results, we must restrict ourselves to some remarks on the experience of the teaching units in the schools.

What the schools were looking for

When the project started recruiting schools to participate in the tasks of the project, candidate schools were asked to state their motivations. The considerations expressed included:

i) The importance of environmental education;
ii) Integration of subjects;
iii) A desire for innovation, such as:
  — more attention in science education to human responsibility
  — more surroundings-oriented education
  — more and better outdoor education
  — more and better practical work;
iv) A planned rather than eclectic integration of environmental issues in the curriculum (existing methods are unsatisfactory);
v) Contacts with similarly tuned schools.

The first consideration was formulated in a very general way, giving little information about schools' motives, which probably expresses an awareness of their responsibility for contributing to a sound relationship between man and nature. Interesting to note is that the second consideration — subject integration — scores highly, almost every school mentioning this motive. Environmental education is obviously felt to offer a natural opportunity to teach in better co-operation with colleagues of other subjects. Looking at these considerations, we see that the desire for innovation in education is expressed both in contents and in didactics.

We may conclude that the main motive for schools to adopt environmental education is the wish to improve the contents and didactics of their regular education. We should perhaps call this a thesis rather than a conclusion, for the danger is clear: if teachers only adopt a few "nice things" as didactic ornaments of regular subject matter, the undesired dispersion of contents will persist and the interdisciplinary character of environmental issues be neglected.

Teaching units

The teaching units are meant primarily to serve as examples illustrating the curriculum design. For teachers they are by far the most interesting and useful products of the project (see Table 1). The units became available in December 1989, as well as a teachers' handbook containing a description of the main concepts and their relationships. Twenty short teaching units dealing with various topics have each been designed for one of the school subjects.

Table 1. **UNITS DEVELOPED IN THE NME-VO PROJECT**

Title	Topics	Subjects	Form	Age	Ability
Wetland	Human use of wetland	Geography, biology	1	12-13	All levels
Meat	Environmental effects and meat production alternatives	Geography, biology	2	13-14	All levels
Fuel	Local contributions to solving the energy (fuel) problem	Geography, physics, chemistry	3	14-15	High level
Traffic noise	Ways of reducing traffic noise	Geography, biology, physics	3	14-15	Average level
Pesticides	Environmental effects of pesticides, and alternatives	Geography, biology	3	14-15	Low level
Waste disposal	Different ways ofwaste disposal and their environmental effects	Geography, biology, physics, chemistry	4	15-16	High level

Note: In Dutch schools, students of different levels are rarely mixed in forms after the second year.

Apart from their contents and subjects, the units differ in structure and in emphasis, ranging from class 1 to 4. However, each unit must:

- Stimulate concern and commitment on the part of the pupils;
- Contribute to a more general understanding of the relationship between man and the environment;
- Contribute to the pupils' understanding of possibilities and restrictions regarding solutions to environmental problems.

The units differ in the emphasis that is put on one or more of these features. In the first year we do not emphasize decision-making by the children themselves, but in the second year we ask them to prepare a meal and consider environmental factors (influence of meat production on the quality of water and soil) as well as taste, money, etc. In the third year the pupils are asked to design a housing development with blocks of houses, green areas and, for example, windmills, a total-energy generator, solar collectors, etc.

Differences between units may also be expressed by marks that only appear in some units, such as contributions to a general understanding of others' influence on realising solutions, to an insight into the pupil's own choice of certain behaviour, to a

general understanding of decision-making processes. The unit must present an actual environmental issue, as well as introduce possible actions.

All units are structured around a key question regarding a practical situation from the world pupils live in, ranging from their personal world (for younger pupils) to that of society (for older students). Use of a key question offers the possibility of environmental education to teach, say, science and geography as tools for decision-making on a personal and societal level (see Kortland, 1987). For example:

- Does man leave room in the wetland for animals and plants?
- What can be done about the influence of meat production on the quality of the environment?
- How can one plan a housing estate and consider the consequences of fuel use on the environment?

The key question is introduced to the pupils in one or two lessons at the beginning of the unit to serve as an orientation. It is then elaborated in separate subject parts, during which the subject's specific concepts and theories are used to clarify the hows and whys of man's activities in the environment, and possible measures to solve certain problems, as well as their restrictions (e.g. the effects of measures at a distance, or in the future). The key question returns in one or more conclusive parts, in which the acquired knowledge (including relevant "school knowledge") and the pupils' appraisal are used to construct a possible answer to the central question.

Experiences with NME-VO materials in the school

Do the units offer an occasion to integrate subjects? Yes, but there are problems. The units are designed to be performed in co-operation (Wetland, Meat and Fuel) or to make co-operation a possibility (Traffic noise, Pesticides and Waste disposal). But after the first trials it became clear that the units often disrupted the regular planning, irritating both pupils and teachers. Or the unit would fit well into the geography class, for example, but the biology teacher would then find his programme delayed. These are problems, however, which can be solved by using unconnected subject parts (felt as a loss by developers and teachers) or by stricter planning at school level.

Another problem is that only some of the teachers had been involved in the design of an environmental education curriculum and of teaching units. Other teachers who took part in the trial of the units often omitted some crucial aspects such as open-research or decision-making activities. This is obviously caused by the understandable uncertainty of teachers in handling those activities. Even in the planned form of the NME-VO project, the environmental education innovation cannot be made "teacher-proof"!

Structural support in school planning is needed. Also, innovations in the regular subjects' curriculum must show explicit points of contact with environmental education. And training, both in-service and pre-service, must prepare teachers for the more controversial issues which are typical in environmental education; as well as for activities that train students' skills in investigation and decision-making. Training must also give teachers insight into the overall goals.

Research among pupils

The effectiveness of the developed units is tested immediately after their first trial by comparing the answers to pre-test and post-test questionnaires. From our evaluations we know that pupils feel that the goal of the units is to contribute to their awareness and knowledge rather than to change their behaviour. The general conclusions concerning the first version of our units are that pupils:

- Do not only associate the word "environment" with "pollution" but also with "nature" (the units do not alter this view);
- Regard wetland mainly as the residence of plants and animals (although the unit considers the fact of man's residing and interfering in wetlands, the "pure nature" image is hardly affected);
- Initially do not see any connection between meat production and air pollution, and here the unit changes this view effectively (asked to suggest measures to reduce air pollution, pupils readily mention reduction of the number of pigs, and although they know that meat can be replaced by other protein sources, most pupils do not propose decreased meat consumption as a way of reducing air pollution);
- Do not see the relationship between deforestation in Third World countries and meat production in the Netherlands (e.g. Thailand and Brazil growing raw materials for cattle fodder in former forest areas and exporting it); the unit hardly changes this view.

The results of this research have mainly been used in the revision of units, but they will also contribute in the future to charting the most significant attitudes impeding a good understanding of man's relation to the environment, or to tracing the most frequently used considerations in making decisions (see also de Jager and van der Loo, 1990).

A curriculum design

One of the most challenging and difficult tasks of the project is the designing of a planned rather than eclectic integration of environmental issues in curricula. First, a curriculum for environmental education must fit into the regular subjects' curriculum. Second, it must be structured and planned in such a way as gradually to lead to a major aim. Third, it must leave room for a variety of activities in local situations, offering students opportunities to develop their own knowledge and abilities. However, fulfilling one condition does not necessarily guarantee that the other conditions will be met. In fact, experience all too often shows the contrary.

In April 1988 we completed a first version of a curriculum, which describes:

- Our aims regarding environmental education;
- Concepts and structures that constitute environmental education;
- A skeleton-like planning of environmental education in the first three years of secondary education;

— A choice of relevant issues;
— A programme proposal in which the four project subjects are incorporated, satisfying both the intentions of environmental education and the conditions of the regular curriculum as far as possible;
— Features of lesson units that express the main objectives in each unit again (described above).

As a result of a government decision, in the near future:

i) Regular curricula will be changed in a far-reaching way; for example: the number of hours for geography will be decreased by about 40 per cent;
ii) Environmental education will be given an obligatory and explicit role in the new curricula for geography, biology and physics/chemistry.

Consequently, our environmental education curriculum design also has the status of a proposal concerning the regular curriculum (which was not expected at the beginning of the project).

Aims in terms of knowledge

Environmental education should enable students to take into account the quality of the relationship between man and the environment when carrying out their projects. The importance of a student's commitment to the quality of the environment is not, however, a curriculum goal which should be assessed. Rather, the aim of environmental education expresses a choice to give students tools for decision-making on a personal and societal level. Six general goals have been extracted from this overall aim:

Relationship between man and the environment:

i) Students need to understand the significance of the environment for man, both at a personal and societal level;
ii) Students need to understand the nature of the influence that man exerts on the environment, both as an individual and as a member of society;

Environmental problems and their causes:

iii) Students need to understand the conflict of interests and their negative consequences on other people;
iv) Students need to understand the physical-biological and social background and causes of major problems;

Solutions:

v) Students need to understand the conditions necessary for solving important problems, given the perspective of a sustainable development of the relationship between man and the environment;
vi) Students need to understand the possibilities and restrictions of solutions to these problems, and the extent to which individuals can contribute to these solutions.

Aims in terms of skills

We also need to practise certain skills in our lessons: skills that enable students to go beyond the examples offered in class, leading them to a more general awareness of environmental issues, of their own and others' concern with those issues, and of possibilities to deal with problems. We can roughly discern three groups of skills:

i) Investigation skills: being able to collect, judge and report upon information from people, written sources, outdoor observations or experiments; to discern factual information from opinions;

ii) Decision-making skills: being able to reflect upon one's appreciation of situations and of solutions; to evaluate alternatives in order to make choices and decisions;

iii) Action skills: being able to actually contribute to sustainable development.

Aims in terms of models

We all have our own concepts of reality, among which is the relationship between man and his environment. We have identified models in environmental research and policy that have proved to a certain extent to be fruitful in understanding this relationship. For example, man can be seen as part of ecosystems in the environment, and at the same time evaluating and influencing these systems. We wish to offer our students such models (in carefully chosen words and schemes) as an expedient to structure their own awareness and concern. These conceptual models may also help teachers and developers to design a path of teaching, enabling them to offer the relevant knowledge gradually.

Sequencing

We tried to achieve a three-year learning sequence of concepts and skills in the teaching units, in which the following steps can be distinguished:

First year

a) *Man/environment relationship:*
Pupils discern important elements and effects of human activity in their environment. They connect the significance of the environment with the interventions of man. They make outdoor observations and report upon them.

b) *Role of values in problems:*
Pupils learn that they and others attach values to elements of the environment. They recognise their appraisal of their own environment. They see that in cases of environmental problems, appraised elements are involved.

Second year

a) *Significance and effects of elements in the environment:*
Pupils discern significance and effects in given situations and report on them.

b) *Role of distance in space and time, and interests in veiling environmental problems:*
Pupils recognise that others may act negatively to a given problem, depending on their vested interests, even when these problems concern the distant future. They conduct a simple inquiry to assess the role of given environmental elements and human interference. They express a personal appraisal of a given problem.

c) *Pupils' own influence on problems:*
Pupils recognise that their own actions influence the environment, even though in a restricted way. They learn that their behaviour and value judgements are influenced by other people. They quote examples of "environmentally friendly" behaviour within their own reach.

Third year

a) *Main causes of environmental problems:*
Pupils learn the main causes of the regression in environmental quality.

b) *Mapping alternative solutions:*
Pupils find possible solutions from sources. They judge solutions on the conditions of a sustainable relationship between man and his environment. They understand the role of conditions and of various interests in the establishment of legal norms and measures. In a simple inquiry, they judge the effectiveness of given measures.

c) *Pupils' own influence on solutions:*
Pupils understand the influence individuals have on possible solutions. They search for addresses and other information; they can write a request or a protest.

d) *Solutions may act as new influences on the environment:*
Pupils see solutions as new interventions in the environment, and discern their advantages and disadvantages. In a simple inquiry, they judge given measures designed to solve problems according to their influence on the environment.

The data collected from the first trials give insufficient information yet about the usefulness of this sequence. We expect to gather more evidence both on contents of textbooks and on teachers' activities in the coming years.

VIII. NORWAY: REFLECTIONS ON A BREAKTHROUGH

Frank Folkedahl,

Kontra Upper Secondary School, Ski

The OECD/CERI project was the starting point of a process in Norway. One of several initiatives was a market-research study on changes of attitude in the local population with regard to the use of detergents containing phosphates. This was a follow-up to a water quality project in which a campaign, initiated by four municipalities in the region south of Oslo (Follo), was launched against the use of phosphates. The objectives of the market research study were to:

- Examine people's attitudes to the use of phosphates in detergents;
- Find out how much people know about phosphates in detergents and their effect on the quality of water;
- Determine what influences people's buying habits concerning detergents;
- Compare the Follo municipalities' concern over the use of phosphates in detergents;
- Determine what steps the consumers want authorities to take to reduce the use of phosphates in detergents.

An extract of a report written by the students describes their work:

We used our marketing lessons for the actual market research, since this is part of the subject and we were supposed to learn about it anyway. The computer lessons were used to feed the computers with information and to treat the results we got from the research. We wrote about the research in our English lessons, and made reports and posters on the subject (some of these were later sent to an exhibition in Telemark in Norway). In our Norwegian lessons we learned about communication and the use of advertising and information to fight pollution and damage to our environment. We also spent some time studying international and local organisations which work for environmental care, such as Green Peace and Bellona.

Students produced a video to show others how they had worked and to inform them of their results. They presented their findings to those who had supported them: experts, politicians from the municipal council, representatives of the school authorities, the local press, etc.

A steadily growing environmental awareness emerged as we were working on this project. "Environmental education must be an integrated part of any subject", says

Vesla Eker, who had participated in the water quality project and is teaching marketing. "We started with communication and proceeded with an environmental campaign", she says. To give the students an idea of what today's environmental policy is like, she focused on the Brundtland Commission's report, Our Common Future (published by the World Commission on Environment and Development). Environmental issues are topical in the media in Norway. "It is therefore urgent", she says, "to persuade the students to read newspapers and watch television...and there is so much material to be considered from the world beyond textbooks."

An integrative approach

Throughout the project period we worked on three levels:

i) Locally (questionnaire on the use of detergents without phosphates; the establishment of an environmental council in the Ski municipality);

ii) Nationally (Department of Environment, environmental pressure groups such as Bellona);

iii) Globally (economy and pollution in developing countries; acid rain in Europe, international agreements and international co-operation against pollution).

The project taught students how to work together towards a common goal. Environmental education is by nature interdisciplinary, and the usual division into non-interrelated subjects will necessarily be too limited where environmental education is concerned. The approach through the natural sciences is not the only way to environmental education, for example. Interdisciplinary co-operation gave students an understanding of the overall perspective and complexity of environmental considerations, and they experienced how their different school subjects could be integrated into one large project.

Breaking barriers

Since this was a new way of working for us, the role of the teacher *vis-à-vis* the pupil had to change, with the teacher acting more as a consultant and advisor giving feedback on the students' work. The teacher showed confidence in the students, who thus acquired self-confidence and a will to prove that they were worth our confidence. Students were encouraged to be responsible for their own learning. They had to work out approaches to problems, find sources for further studies, sort out and reflect on information, make decisions, plan, organise and evaluate what they [illegible] Creativity and challenges became key words of this project.

The students had occasionally to leave the school premises to establish relationships with the public administration as well as with influential people. This taught students that they had to rely on experience if they were to learn anything, environmental issues being poorly covered in textbooks. To make the curriculum more relevant, it was necessary to co-operate with experts off the school premises. For instance, while working on the water quality project questionnaire, we benefitted greatly from the help

of a civil engineer of the drainage administration of Lake Nordre Oyeren, and of a statistician and a manager at the Centre for Experimental Design and Data Processing at the Agricultural College of Norway.

The media became interested in the project and in particular in interrogating the students about their work, which encouraged them to start reading the local newspaper, although many had considered it boring because they felt that the papers were not really talking to them. The students showed that they are able to carry out interviews, do market research on a given product or service, conduct campaigns, work with computer services and process data. We hope the public and private sectors will now make use of all the knowledge accumulated in the upper secondary schools.

International agreements being necessary in order to solve many problems, the importance of the global aspect of environmental education was not omitted. In this respect it became evident to students that the international means of communication is foreign languages, English in particular.

When we first started working with environmental education over three years ago, we had no experience. Our work progressed very slowly, and many students and teachers looked upon it as unimportant supplementary work. In the course of that time, however, interest in environmental education increased considerably in the entire school. Many teachers have changed their educational methods, and decision-making by the students, project work, interdisciplinary co-operation, and environment as an overall perspective have now become part of the daily routine for certain teachers. Students at all levels receive basic environmental education in several subjects, and interdisciplinary mini-projects have been conducted.

Two students' views on the project

Finally, we held an interview with two final-stage students who were participants in the OECD/CERI conference in Linz: Hege Schonhowd of the economics and marketing branch, and working on the Water Quality Project, on the questionnaire, on the translation into English, on graphic design, on the exhibition poster, and a main contributor to the information booklet for the exhibition; and Raghild Aune of the languages and public administration branch, and working on the School Development Project, aiming at the integration of environmental education in the school subjects Norwegian and public administration, and the photographer of the trip to Austria, of the exhibition work and its presentation:

> *This project has made us more conscious of the environment. It is much nicer having new approaches to teaching. Variation often makes it easier to see new connections. This has made it clear to us that all subjects are part of a greater dimension.*

They were also pleased with the fact that they have been largely responsible for their own education:

> *It clearly motivates us if teachers have confidence in us. Then we are far more positive to education in general. All in all project work is too scarce in the curriculum. But we also feel that there must be sufficient room for traditional teaching methods.*

The students were far from happy with governmental attitudes to pollution:

They are doing next to nothing. Instead, the government should see to it that citizens can make an environmental effort themselves, i.e. to ticket goods with environmental labels would be a good idea. Public authorities should also be far more concerned with proper environmental products. This includes advertising as well. It is also horrifying that unsafe working conditions as well as dangerous discharges are frequently neglected.

The students denied the idea that this project has made them more pessimistic about the future:

People are waking up. In the long run conditions will improve. We have gained in self-confidence with this project. We know, and we have proved to our teachers, that we can all do something to save the environment, whether we are students or not.

IX. PORTUGAL: OPEN ENVIRONMENTAL WORK

Beatriz Chito

Escola Secundaria da Venteira, Amadora

The National Institute for the Environment proposed that we participate in the OECD project. The idea seemed to be a good one: the work to be done was certainly more difficult, it would be necessary to look for information outside the school, but the exchange of views and the contacts established would be much more important — besides, the "discovery" of the town was going to be an adventure. I asked the pupils what they thought of it. Fine! They loved team-work, and an extra effort would be no problem. I contacted the other teachers of the class, and then came my first disappointment: their motivation was low, one was undergoing training and the other had heavy family responsibilities. But at least the board of directors welcomed the suggestion, authorised the proposal and put at our disposal the small resources available.

The first step was a "brain storming" on the town. There were the most classical suggestions as well as those put forward for fun (at 14 years of age everything is possible!). All ideas were thoroughly discussed, including that of taking as leitmotiv the evolution of the town in time. Half a dozen themes on the past, present and future of our local environment were chosen by groups of three or four pupils.

The next step was to elaborate the list of information sources: I contacted the municipal and regional institutions (Town Hall, municipal library, documentation centres, local offices); the pupils contacted their families, neighbours and friends. At the same time we visited the town and its suburbs in search of a "lost treasure-town".

Pupils enjoyed assuming the attitudes of an adult when someone like a town councillor was interviewed; it was interesting to discover the old farms, and to find that parents and grand-parents knew so much about Amadora. A few difficulties arose, such as: What were we going to ask? How were we going to look for information among so many newspapers and books? What about the nasty neighbour who refused to answer our inquiry? And the old noblewoman who had promised to receive us and then didn't? One group had to abandon their theme, "Amadora in the romantic literature of the past century", owing to difficulties in obtaining information, and replace it by another.

The hardest step was how to organise and treat the information, how to draw graphs and maps, how to elaborate a text; in a word, how to communicate. It was a difficult stage, since the pupils' written work was unsatisfactory both as to form and content; it was difficult to assemble all the members of a group outside class time (two

hours a week was obviously too little), and there was always pressure of other school work. The establishment of goals, methodologies and schedules required the intervention of someone with more experience, in this case the teacher.

A month later everything was ready. Each group showed its work to the class, explained what they had done, what results they had obtained, what doubts and difficulties they had. We then all evaluated the work: each pupil critically evaluated his/her own work, the work of other group-mates, and the work of everybody. The rest of the class were quite demanding, drawing attention to certain faults and to some laziness, but they praised the commitment and the final product.

After the necessary corrections had been made came dissemination: first to the school, then to those closely involved, and finally to the community (through an exhibition in the Town Hall). We collected different opinions, asked for judgement and gave explanations about our work. A file was established on the global evaluation of the work, of the participation of the pupils, teacher and the institutions involved. The material was assembled and reproductions offered to the National Institute for the Environment and to the Town Hall.

Finally, the most difficult moment came: we had to choose the lucky ones, who would go to Linz to show our "production". The groups could not make up their minds and at last decided to draw lots: Patricia and Carla would take part in the Conference. We returned having made many new friends and full of energy to go on with this work. However, things are sometimes different from what we would like them to be: I stopped being a teacher, and the boys and girls went on with their studies but in other schools. However, a deep friendship between all of us and a better knowledge of Amadora is what remains from this work, and of course we still keep our rendezvous for a summer picnic!

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X. SWEDEN: ENVIRONMENTAL INITIATIVES AS PART OF SCHOOL LIFE

Nils Jan Rapp

Brattebergskolan, Öckerö

Off the port of Gothenburg on the west coast, there is a group of ten sparsely populated islands belonging to the municipality of Öckerö. Poor soil had for long forced the population to earn their living from fishing. It was the principal industry and everybody was dependent on it. Those who were not fishermen worked at the shipyards, building or repairing fishing boats. In the 1960s the fishing industry underwent a crisis which forced many fishermen to become motor mechanics at Volvo in Gothenburg. Thanks to improved means of communication, they could remain living in the archipelago, commuting from their homes. By that time, people had also begun to move from the city onto the islands, which now have at least 10 000 inhabitants.

On nine islands out of ten there is a junior middle school or a middle-level school. Pupils stay on at their island school until they begin going to the Bratteberg school which is a senior-level school. Bratteberg school is situated on the island of Öckerö and the pupils get there by boat, bus or bicycle. The school opened in 1967, and until 1976 was a traditional comprehensive school which like any other school did not care very much about what happened outside it. But ever since the school opened, a pedagogical discussion had been going on. As a result, the school was divided into three departments, called houses, consisting of two 7th forms, two 8th forms and two 9th forms. This was done to give teachers and pupils the opportunity to get to know each other better.

In 1976, however, a survey among the pupils revealed that they wanted more influence on their education. This resulted in an experiment of three days in each week being set aside for activities different from normal instruction. During these days the pupils were to assume greater responsibility and the teacher became mainly a supervisor. The experiment was extended for the whole of the spring term of 1977. The pupils were asked to set their own timetables, take initiative, seek knowledge and look upon their teacher as one resource among others.

The experiment aroused strong opposition among some parents who were afraid that their children might not acquire adequate knowledge to pursue studies at the upper secondary school in Gothenburg. The spring term ended in a strike among pupils for better education. From 1977 to 1981 Bratteberg experimented with free distribution of

the time quota allowed per subject. This gave pupils the opportunity of working on different projects during 13 lessons out of 35 a week. The experiment influenced the new curriculum of the comprehensive school and permitted Bratteberg to continue its project work.

Project studies

Now the stormy period is over and six lessons per week are devoted to project studies as a complement to traditional education. Each pupil (from the 7th, 8th and 9th forms) can choose to work with pupils from other classes in vertically integrated groups on three projects out of about 40. These projects combine theory with practice, and they are all related to the community, which means that, additionally, the pupils are doing something of value for others, e.g. sewing children's clothing for a developing country, running the school library, producing a community radio programme, breeding lobsters, laying out a park.

Project studies also include in-school production such as cultivation of tomatoes, flowers and herbs, or restoration of the "Hawila", the last ship in our community to serve as a school sailing ship. Most of the projects, such as fish farming, the ship, radio station, greenhouse and windmill, are now over ten years old and are developing new branches.

Market gardening

In the summer of 1978 a group of teachers and pupils pulled down an abandoned 32 metre-long greenhouse in the village of Paryd near Kalmar on the east coast of Sweden. With the permission of the School Board, three greenhouses were then put up in the school yard, and a herb garden was laid out by the pupils. During the spring, pupils raise plants which they sell at the school every Saturday in May. The range of plants includes tomatoes, cucumbers, leeks and celery. Sixty pupils divided into three groups run this project. During the summer, tomatoes are grown, sold to the school and eaten in the canteen. In 1982 a herb garden was inaugurated, and in 1987 an experiment in growing basil, thyme, marjoram and melissa was carried out. Pupils gathered herbs from the nursery for a company that sold samples of prepacked fresh-cut herbs to some ten shops in Gothenburg. Herbs have become a specialty, with retailers — at first sceptical — now being convinced of the quality of the school's produce.

In June 1984 the pupils had laid out a herb garden at Kattlunds, a medieval farm in the south of Gotland. Now it is Öckerö's turn to have a herb garden, located in the centre of the district. The local authorities have agreed to let the school make use of a former nursery for three years. If the group manages this well, public opinion will exert such pressure that this project also will survive.

Fish farming

Already in 1976, some pupils and a teacher had asked themselves: "Why do we hunt fish? Why don't we cultivate the sea as the farmer cultivates the soil?" Out of

these questions grew various fish-farming projects. The pupils, with help from a former fisherman, have made net cages for rainbow salmon, and have learned to repair and make new nets. The group now has a stock of 1.5 tons a year of salmon in the cages. Together with students from the university, they have also experimented with wintering of rainbow salmon in sea water. This project has initiated fish farming in this part of the west coast and, in the beginning, pupils held courses in fish farming for adults! There are now several commercial fish farms and a fish breeding society.

When one of the projects led to the conversion of an unused herring salting-house into a modern processing factory, it was quite natural for the experimental kitchen of the school to use herring fillets and to try out recipes in the canteen. One of them, the "Bratteburger" — a herring hamburger — was eventually produced commercially. Pupils from the experimental kitchen helped to market the dish at food fairs and in shops.

At the small upper secondary school now in existence on Öckerö, students who participate in fish farming and inshore fishing courses assist pupils from Bratteberg in breeding lobsters, in an attempt to increase the lobster stock in the sea. Such projects owe their existence to financial support from an association known as "Towards Better Knowledge".

This association owns all the costly projects at the school — the greenhouses, fish farms, windpower station, radio studio, two ships and a coach. The association — *Mot bättre vetande* in Swedish — was founded in 1978. The Swedish word *mot* has a double meaning: both "towards" and "against", which was of great significance when the name was chosen, since the school had been criticised by some parents, and the association was founded to break the isolation of the school. It wanted the pupils to learn to take risks and responsibility and thus improve their knowledge both in theory and in practice. The association makes a profit on several of its projects but is dependent on grants from funds, foundations, authorities, and on gifts from companies. Three people are employed on its ships and fish farms; the 1987 turnover was SKr 2 million. It has now taken the initiative to start a project to develop trade and industry on the northern islands of the municipality. Teachers, parents and pupils are members of the association, which means a great deal to the local community.

"Hawila"

The "Hawila" project started in 1978 when the last cargo ship in the islands was falling into decay. It was one of the first and biggest projects of the association. After thousands of hours' work by pupils and teachers, and at a cost of at least SKr 1 million, the "Hawila" was launched in 1984. The ship sails from May to October and all pupils make a sailing trip for one week. Apart from learning to sail, they get to know the Province of Bohuslän, its history, nature and culture.

Certain pupils follow a special course in navigation, and in this way the school acquires skilled sailing instructors. They in turn teach their schoolmates to sail and eventually take command of the ship. Stimulated by the successful work with the "Hawila", the project group tried to build a new sailing ship. When a Norwegian lifeboat came up for sale, the association bought her for SKr 426 000 to be used as a training ship.

The projects of the school and the association are still developing. In July 1988 the association received a favourable loan to buy a coach for use by the municipal schools on camping and study tours.

Windmill

On the roof of the Bratteberg school can be seen a windmill. A team is trying to develop a module system of wind-power stations which is to be used to generate electricity or pump water in a developing country. The pupils have designed and made all the parts themselves. They have undertaken a difficult task and are therefore assisted by university students and students of the upper secondary school. From the roof they can see the experimental station on the neighbouring island of Hönö, which is also a result of their work.

Radio station

It is important that the home district be represented in the media. Accordingly, pupils have been producing their own radio programmes for the local station at the school's studio since 1979. The group also makes video documentaries of 25 minutes which are shown at the school once a month.

Conclusion

The pupils taking part in the projects have learned to accomplish a variety of activities. They can see the consequences of their actions: careless sowing, planting or watering quickly shows; fish die if they are not fed during the summer holidays; and customers express their appreciation of healthy plants. The person who has learned most of all since 1978, of course, is the supervisor, who never stops learning. Both Bratteberg and the association want to show that young people can make a contribution to the community, that they can participate in the development of their home district and take responsibility for the environment, and that they can help to solve problems and produce and spread new knowledge.

XI. SWITZERLAND: FIGHTING THE WASTE MOUNTAIN

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Pestalozzianum, Zürich

In 1984 the KEZO incineration plant *(Kehrrichtverbrennungsanlage Zürcher Oberland)* decided on a training programme under the motto "Fight the Waste Mountain". As well as the symptoms, the underlying causes were to be tackled, not only to reduce but also prevent waste. The training programme, funded through the "Waste Franc" — that is, one Swiss franc of the annual waste duty per person of the catchment area — consisted of local community seminars for authorities and industries, and of the KEZO school project.

Approved by the supreme educational authority of the Zürich canton and by the local school authorities, the project was presented to the teaching staff, who were free to apply for "waste lessons". Specially trained "waste teachers" then gave "waste lessons" in the kindergarten, in the 2nd and 5th grades of the primary school, and in the 8th grade of the lower secondary school. About 80 per cent of the teachers of these grades participated in the project. They were trained by attending various events: visits to plants, exchange of experiences, etc.

The waste-teacher team aim at sensitising, motivating, informing, and confronting the pupils with possible activities concerning the treating of waste according to a new scale of priorities: first, prevention; second, reduction, utilisation and recycling; and only third, waste disposal. Four waste lessons are planned during the schooling of a pupil. In the 5th and 8th grades the lessons are integrated into biology instruction. Prior to the lessons, parents are informed by letter.

Further activities come under the form teacher's responsibility. As experts, the waste teachers try to convince the pupils of the necessity of changing attitudes and they offer new directions. They also reinforce the position of the science teachers. Examples of immediate effects of the project have been the organisation of composting plants at the school and in private households, the setting-up of separate waste containers in private households, and the increased utilisation of community deposits.

XII. EXPERIENCING INNOVATION: WHAT MAKES A GOOD CASE STUDY?

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Introduction

In the Environment and School Initiatives project, teachers were asked to undertake action research into implementing an environmental education process which fostered both students' awareness of their local environment and those dynamic qualities associated with initiatives to improve it. Participating teachers were also asked to produce case-study reports of their research. The idea was that, together, the reports would provide the basic documentation on the range of implementation issues, and the strategies used to resolve them. This basic documentation would not only enable teachers operating in different local and national contexts to share and draw on each other's experience; as a distillation of the experiences of teachers and students it carries implications for educational policy.

It was my job as a project consultant to derive policy issues from the teachers' case study reports. My problem in doing this was handling the very different sorts of accounts which were produced. Some case studies did not describe the process in a way which helped readers to experience vicariously the process as it was actually lived by the teachers and students involved. These reports tended to provide surface accounts of the process in the form of factual descriptions of strategies, events and outcomes. One had little sense of the problems and issues which emerged in the process of implementation, of how they were interpreted and understood by participants, and of how the latter responded to them in practice. Such reports provided little indication of being grounded in teachers' systematic reflections about their experience of innovation. In other words, the case studies were not accounts of an action-research process in which teachers (and students also) reflect in and reflect on their attempts to implement educationally worthwhile change.

Other case studies (a substantial minority) did, however, provide reflective accounts of the experience of innovation. Below, I have outlined a personal view of three of the criteria an action-research-based case study would ideally satisfy. These criteria are derived from my own imperfect understanding of the action-research process.

But they might provide a starting point for developing a view of what constitutes quality in self-reports about the experience of innovation.

Criteria

The case-study report should:

i) Provide a narrative account of the implementation process as it is experienced by participants; it should be highly readable, using non-technical language to tell a story as it unfolds over time and giving the reader a sense of what it was like to be involved;

ii) Portray the innovation in its context, highlighting those aspects which illuminate the experience of those involved;

iii) Focus on problematic aspects of the experience of the innovation;

iv) Reflect on the problematic aspects from different points of view;

v) Show how one's own and others' understanding of problems and issues can evolve with new evidence;

vi) Describe the curriculum and pedagogical strategies undertaken in the light of a developing understanding of problems and issues;

vii) Assess the consequences, both intended and unintended, of curriculum and pedagogical strategies for the quality of the implementation process;

viii) Describe, justify and critique the methods and procedures used to gather and analyse evidence about the experience of innovation.

Applying the criteria: an example

The reader may now like to examine the case study "Waste Project — District Oberwart" (see following section) in the light of the above criteria. It was not selected as a model of a good case study perfectly exemplifying all the criteria. However, it is an illuminating and interesting account, and I subsequently examined it against the criteria. The main elements in the report reflect most of the criteria to varying degrees. In the first section there is a brief but very readable narrative account of the experience of the project in action.

Criterion 1. It helps us to feel something of the excitement, challenge, and risk experienced by the teacher and students.

Criterion 2. We learn that students conform to "traditional concepts of people in rural areas, well behaved, industrious and only very rarely ready to develop personal initiative". This explains the teacher's attraction to a project which aspires to develop dynamic rather than passive qualities, and thereby offers the possibility of overcoming perceived negative elements in the local culture.

Criterion 3. The innovation is experienced differently between girls and boys, securing a higher degree of commitment amongst the former.

Criterion 4. The teacher reflects on alternative interpretations of this gender difference in the light of evidence he collects to test them.
Criterion 8. In doing so he explains the methods by which he collects and analyses evidence.
Criterion 5. The outcome of this systematic reflection is a modified understanding of the relevant dimensions of the problem.
Criterion 7. This involves eliminating one initial hypothesis; namely, that the gender difference is an unintended consequence of the pedagogy.
Criterion 6. There is little in this case study concerning the development of action strategies in the light of the analysis, e.g. to secure a greater degree of commitment from boys.

A good case report need not have to satisfy all criteria to the same degree. It all depends on its content. Thus, for readers concerned with the educational motivation of girls from rural communities, the detailed analysis of the girls' motivation may satisfy their information needs. Such readers may also require less detailed contextual description than those who are unfamiliar with the mores of traditional rural communities. This case report, which is sparse on contextual detail, is nevertheless likely to satisfy readers.

The quality of a case report depends on the information needs of its intended audience(s). The emphasis given by the case study's author(s) to each of the criteria should be determined with the intended audience(s) in mind. And it is helpful if they are identified at the beginning of the report.

AN EXAMPLE: "WASTE PROJECT — OBERWART DISTRICT" Emancipation through Environmental Projects

Karl Schweitzer

Bundeshandelsakademie und Bundeshandelsschule Oberwart, Austria

Oberwart is a small town with a population of 7 000, which has become the centre of South Burgenland in the course of the last two decades. I teach the subjects geography and economics as well as physical training at a commercial high school and a commercial middle school. The schools are attended by 294 and 443 students respectively aged 14 to 19. About 60 per cent of the students are girls. A total of 42 teachers teach at both schools (1987/88). The region of Oberwart has also drawn students from Eastern Styria and Southeastern Lower Austria.

The average student in this region conforms to traditional concepts of life in rural areas: he or she is well behaved, quiet, industrious and only very rarely ready to develop personal initiative. This type of behaviour may be linked to the fact that rural families tend to be father-dominated, and children are accustomed to submissive attitudes. Much of the teaching at school is mainly of the up-front style. This traditional context, as well as my discussion with parents and students triggered my motivation to start project work with students.

We began by doing many small projects, primarily dealing with Third World topics. Some success with this work stimulated me to start a bigger project. In view of the current situation, it was obvious for me to select an environmental topic:

The Oberwart Waste Project

In a press release of October 1985, H. Strutzmann of the Youth Award Office of the First Austrian Savings Bank gives a very good description of the first project phase:

A letter to politicians:

Everything started with a letter: Steyrer received it, Zilk received it, Sinowatz received it. And Mock received it too — that very thoughtful letter which started with the words: It is with great sadness that we must note that our environment has almost completely perished owing to reckless construction activities and unrestricted production. When will we finally realise that we are cutting the ground under our feet? Hopefully before it is too late. At the end of the document two open questions were

asked: "What ought we to do against it in the near future? What will you do against it?"

The senders of this sharp letter, which was also sent to large industrial corporations, live in Oberwart, Burgenland. In addition to attending the same school, i.e. the commercial high school, they are united by the awareness of "doing something to prevent the decline of nature before it is too late". In this first phase at least they succeeded in getting half an hour's time from politicians and top managers. The pupils were invited to hold a personal interview with Helmut Zilk, the mayor of Vienna, and the other politicians also showed serious willingness to discuss this very important subject.

In his meeting with the Oberwart pupils, Dr. Zilk indicated that criticism alone was insufficient to achieve something — a repetition of what we had been told time and again inside as well as outside school. However, our motivation had grown so strong that we dared to tackle a big project, and in painstakingly detailed work we drafted a cadastral map of the waste deposits in the Oberwart district. The map was publicly highly commended as an "important aspect of practical environmental work which can essentially contribute towards increasing the general environmental awareness". It was called an example of active environmental protection and committed ecological fieldwork.

Several events had a very motivating effect on our future work: the map received the "Award of Environmental Technology" from the Ford Foundation; the First Austrian Savings Bank gave us a major award, and we won first prize in a creative competition of the Burgenland Waste Association. All this public success encouraged and strengthened us for our subsequent discussions and encounters with the public offices and authorities responsible for questions relating to the environment, involving even the office of the governor of Burgenland.

But it was certainly with our educational work that the most important phase of our activity was reached. Information evenings were organised in almost every local authority of the district, which provided an opportunity to enter into very constructive discussions with the local population. The main focus was on providing information about the dangers of random dumping, about waste avoidance, separation of different types of waste, and recycling. We established "eco" tips for shopping, the household, vegetable gardens and orchards, and presented a multi-media show demonstrating environmental damage in our immediate neighbourhood.

We felt certain to obtain support for our endeavours as a result of such informative evenings. These expectations were impressively confirmed by developments such as:

- The shutdown of several illegal dumps;
- The installation of collection points for problem waste in the large local authorities;
- Employment of consultants in waste questions.

Definition of the problem for the case study

At the beginning of the project, about 50 pupils from three 2nd and three 4th forms had participated in the work, with boys and girls being about equally represented.

Towards the end of the project the situation had changed, with girls showing increasing commitment whereas the opposite effect was noted with the boys. This development became particularly obvious when 14 girls but only two boys registered for a seminar aimed at the training of speakers to inform and educate the public regarding the waste situation. The series of lectures following this seminar were almost exclusively attended by girls.

In the school year 1987/88, girls became the main proponents of the project and asserted themselves also in other fields: as class and school representatives, in leading positions in youth groups, in ecological activities and, interestingly enough, also in sports clubs.

I became interested in the reasons for this high representation of girls. First considerations led me to three possible explanations:

i) Girls can be more easily motivated by a male teacher than boys, to commit themselves to a concern beyond the usual measure;

ii) Girls do not belong to clubs as much as do boys and therefore have more time available for project work;

iii) Project work encourages girls to break from their traditional roles, to distinguish themselves, and to gain independence and autonomy.

Each of these attempted explanations seemed plausible and I therefore sought ways to use data better to assess their relative values. The following three sections explore the study of these assumptions:

i) Was it easier for a male teacher to motivate girls for the project than boys?

To collect data for this question, I used a questionnaire in which pupils assessed my teaching and myself as their teacher. Sex-specific differences in the evaluation would be considered as a first hint to a positive answer to this question. Since my pupils came from two age groups (2nd and 4th forms) with three parallel forms each, I asked each form to name three male and three female pupils to give feedback on my teaching by means of an anonymous questionnaire. I then gave the questionnaire to three pupils of each form (36 questionnaires) without informing them of the reason for the survey. The majority of the questionnaires were filled in by groups so that a larger number of pupils could be included in the survey (care was taken that the groups were only boys or only girls).

These data do not, however, give any conclusions as to sex-specific differences in the evaluation and assessment of a male teacher.

ii) Do girls have more spare time than boys?

As a boy pupil admitted (on March 6, 1987):

Honestly, I might have become more deeply involved in this matter. But there are so many other things to do. I do not have sufficient time. Probably this is the same with the other boys. In my case it is certainly only the lack of time. I personally would have been interested in this subject.

Questionnaire

[Note by encircling the respective number to what extent you agree or desagree with the statement.]

	Strong disagreement	Disagreement	Neither/nor	Agreement	Strong agreement
1. Has shown understanding for the problems of the pupils	1	2	3	4	5
2. Was willingly accessible to pupils outside teaching	1	2	3	4	5
3. Has stimulated pupils to subject-related discussions	1	2	3	4	5
4. Has stimulated pupils to express their opinions	1	2	3	4	5
5. Has stimulated pupils to independent, critical and exact thinking	1	2	3	4	5
6. Has promoted the creativity and intuition of the pupils	1	2	3	4	5
7. Has taken care that each pupil participates	1	2	3	4	5
8. Has illustrated and made understandable the practical value of subject-specific knowledge	1	2	3	4	5

The results for forms 2a, 2b and 2c were as follows:

Boys					Girls					Question	Boys					Girls				
1	2	3	4	5	1	2	3	4	5		1	2	3	4	5	1	2	3	4	5
–	1	–	5	3	–	2	3	–	4	1	–	4	5	–	–	2	3	4	–	–
–	–	1	2	6	–	–	1	2	6	2	–	–	3	2	4	–	–	2	–	7
–	1	1	1	6	–	–	2	3	5	3	–	–	2	2	5	–	–	–	4	5
–	1	1	2	5	–	–	–	2	7	4	–	–	2	4	3	–	1	–	7	1
–	–	1	4	4	–	–	–	3	6	5	–	–	1	6	2	–	–	1	2	6
–	1	–	3	5	–	–	1	2	6	6	–	–	3	5	1	–	–	–	7	2
–	–	1	5	3	–	1	2	4	2	7	–	–	5	1	3	–	2	3	4	–
1	–	2	2	4	–	–	7	2	–	8	–	2	2	4	1	–	–	3	5	1

And a girl (during the same interview):

Among the boys there are also some who go in for sports. For this they need a certain amount of time; and then there is [often] soccer or motor cycle.

To investigate this question in greater detail, I conducted a survey on October 10, 1987 in all 2nd and 4th forms relating to pupils' commitment to clubs and to possession of motor cycles, with the following results:

Of a total number of 54 boys there were 65 memberships in clubs, with a quotient of 1.2. For 80 girls the survey showed 32 memberships, a quotient of only 0.4. Club membership for boys is thus three times higher than that for girls. An explanation of this is that in rural regions, spare-time activities are very much characterised by traditional male pursuits such as soccer and the fire brigade. There is only one single ballet

Form	Pupils total*	Soccer		Theatre		Fire brigade		Tennis		Music		Skiing		Basketball		Curling		Chess		Others	
		m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f	m	f
2a	22 (11)	4	–	–	–	–	–	1	2	3	–	1	–	–	–	–	–	–	–	1	–
2b	28 (21)	1	–	1	–	2	–	1	1	–	1	–	1	–	–	–	–	–	–	1	–
2c	27 (17)	3	–	–	–	1	–	2	3	2	–	–	–	–	2	–	–	–	–	2	3
4a	19 (5)	6	–	–	–	1	–	1	1	2	1	1	–	–	–	–	–	3	–	1	2
4b	19 (14)	2	–	–	1	–	–	1	3	1	–	–	–	–	–	1	–	–	–	3	5
4c	19 (12)	3	–	–	–	–	–	1	–	–	1	–	–	1	–	1	–	–	–	5	2
	134 (80)	20	–	1	1	4	–	7	10	8	4	2	1	2	3	2	–	3	–	16	13

* Number of girls in brackets.

school in the district (listed under "Others", since only one girl attends), in contrast to 50 soccer clubs. The result of the survey thus confirms my assumption that boys have a far wider range of spare-time activities available in the district of Oberwart and are correspondingly taking advantage of them.

iii) Is the project a welcome opportunity for girls in particular to acquire status?

The social position of girls is different from that of boys. In a typical village in Southern Burgenland, if mother and daughter behave as do father and son, this is nevertheless not the same thing, according to the moral standards of the villagers. The following excerpts from discussions with girl pupils serve as an illustration:

My brother is one year my junior, yet he may do things I would never be permitted. (Andrea, 16 years)

In our village you are sometimes made to feel that girls are "second-class" human beings. (Margot, 17 years)

Time and again I am angry with my mother when she states that something is "not for girls". (Waltraud, 17 years)

Normally, girls are well guarded and prepared for a proper marriage. (Eva, 17 years)

Against this background, three observations gain significance:

The first observation: From talks with "concerned" parents I learned that they consider the project work in which their daughters participate to be controllable, serious free time, since it is a school activity taking place under teacher supervision. They consider the project as an opportunity for organising meaningful spare-time activities. On parent-teacher day in February 1987, mothers of deeply-committed female pupils reported:

I am very happy that my daughter largely dedicates her spare time to project work and does not sit in the café as so many others do.

I consider this project work a meaningful way of spending one's spare time. In addition, it leaves girls less time to get silly ideas.

The second observation: On the occasion of public appearances by pupils, when parents tried to belittle the environmental problems presented in lectures, I witnessed an unexpected degree of aggressiveness among the girls, particularly when their competence was challenged in discussions following a presentation. Statements such as "You are by far too young. What could you possibly tell us?" repeatedly gave girls the opportunity to act out the generation conflict with their elders.

The third observation: In the course of the series of public appearances, the girls' self-confidence grew considerably. After a few events a team of female pupils was already able to work completely independently. Dealing with public authorities and representatives of the media became a matter of course for them, as was impressively confirmed during a live broadcast from Radio Burgenland (Citizen's Radio on January 22, 1987) when two pupils acted completely unself-consciously and participated in the broadcast without any problem.

All three observations seem to confirm the assumption that girls considered the project an opportunity to gain status and to show what they are able to do in a highly topical and socially accepted area. The variety and contradictory nature of environmental questions made it easier for them to handle the generation conflict with their parents and with adults in general, since the environmental topic and their knowledge in this field placed them in a strong position.

Conclusion

More available spare time, and in particular the increasing dissatisfaction of girls with their social position, would seem to be responsible for their strong commitment to the project. It remains to be seen whether similar phenomena, pointing to an "emancipatory function" of environmental projects, is observed in other schools.

Part Three

PERSPECTIVES

I. THE EDUCATIONAL PERSPECTIVE

Peter Posch

The development of environmental school initiatives indicates a change of balance between a static and a dynamic learning culture. This chapter addresses the recognition and development of a new culture of teaching and learning at school. It will successively outline characteristic features of the existing "static" learning culture; compare this approach to learning with recent social trends necessitating changes in the school; discuss the complexity of the problem, desirable changes for a new culture of learning and their implications for the in-service training of teachers.

The static culture of learning

The school is one of the most important institutions to prepare young people for their future lives while contributing to the maintenance and further development of society. Schools have always been expected to cope with conflicting demands, and this may be one of the reasons why teaching is a strenuous activity. On the one hand society wants teachers to transmit a certain body of knowledge that conforms to social values. On the other hand they are expected to help young people to become independent and able to decide for themselves and to become "critical", i.e. to discriminate, reflect and be able to evaluate. Teachers should contribute to the development of all students and should compensate for social handicaps, but the world of work demands reliable information on performance and a corresponding system of selection and examinations.

In the past a certain relationship has been established between these demands. In simplified terms, it can be summarised by the expression "static", i.e. not moving autonomously. We are confronted with a culture which does not expect the teacher or the student to define and tackle problems independently and to monitor themselves. It is therefore no coincidence that, generally, a mechanical input-output model is used to describe such a culture of teaching and learning. The idea behind this model is that production factors (input) operating in a certain combination (process) lead to the generation of knowledge (output) (Haertel *et al.*, 1983).

The prevailing culture of teaching and learning at school (and the related concept of education) can be characterised thus:

— The knowledge to be imparted is largely predefined (by syllabus, approved textbooks, etc.) and consequently highly structured. Education is considered to be the ability to have command over this knowledge;

— This predefined aspect of knowledge corresponds to a dominant position of teacher and textbook as sources of education;
— The student is considered to be an isolated recipient of knowledge. Within this perspective, communication and co-operation among students is dysfunctional;
— The knowledge thus imparted is of an established nature, beyond dispute and debate and therefore partly irrelevant. Often it is considered to be useful in terms of experience gained from past solutions to problems, but at the same time it is of low significance because its static character precludes the learner from making personal contributions (Tenbruck, 1975);
— The values to be transmitted by this framework of knowledge correspond to its prestructured character: discipline, diligence and a sense of order.

In the past the static orientation to life in school corresponded to a more traditional society: the job structure was relatively stable, the requirements fairly clearly outlined and only subject to slow changes. There was high demand for discipline, diligence and a sense of duty, and a rather low demand for initiative, independence and individual responsibility. Co-operative forms of work and work-related communication were not required and could even be considered a threat.

For the vast majority of the population, the transmission of such specific bodies of knowledge and conformity with established hierarchical structures seemed sufficient. As long as the social and economic structures were stable, few persons (entrepreneurs, politicians, artists) were called upon to provide the dynamic functions necessary for the maintenance and development of the social system.

Social changes

Probably the most powerful pressures in support of the democratisation of dynamic qualities come from changing patterns of work. The OECD/CERI studies on patterns of work have provided some interesting findings to support this thesis (OECD, 1986a):

— The new technologies tend to eliminate repetitive and routine jobs. One result seems to be a general up-skilling of jobs;
— There is a clear trend towards more team-work. The man/machine relationship is being replaced by an interaction between teams and technical systems. As a result, increased emphasis is put on communication and social skills to complement technical expertise;
— Increasingly, employees are expected to perform a greater variety of tasks ranging from planning to evaluation. There is an increased emphasis on polyvalent skills, on the multi-function employee;
— The intervals between training and work are becoming shorter. As a consequence, the readiness for continuous learning and its cognitive and attitudinal correlates are considered more and more important.

Closely linked to this trend is the increasing social pressure for and economic feasibility of participation in decision-making. This too promotes the democratisation of dynamic qualities. If the top-down mode of decision-making is questioned, then several qualities expected from the top level must also be expected from the lower strata in the

social hierarchy. There is evidence for an increase in participative management and in the delegation of decision-making and problem-solving down the hierarchy. The CERI study found that "more and more decisions are being made at lower levels within the corporation" (OECD, 1986a). There are similar trends in communities in the proliferation of civic initiatives.

A third source of pressure for dynamic qualities is the decreasing capacity of governments and other large organisations to solve problems such as unemployment, environmental damage, crime, etc. This apparent inability creates a demand for individual initiatives. If certain services can no longer be provided, the expectation naturally develops that people should care for themselves. The enormous increase in the number of local initiatives and self-help groups is strong evidence for this trend.

Finally, the extent of individuals' unstructured time (spare time or leisure time) has been and is still growing. Concurrently there is an increasing need for individual decisions on how to structure this time and also to redefine the concept of work. In addition, the available choices have multiplied, as have the problems of making meaningful use of this time (Aida, 1987).

The fact that the new types of work organisation involve increasing complexity of decision-making, as well as different relationships to hierarchical structures, makes it more difficult to function along the lines of predetermined problem-solving. Problems and solutions tend more and more to emerge from specific situations, and require active problem-solving skills rather than memory-retrievable predefined solutions. Qualities which were considered normal in the industrial era — the willingness to perform monotonous mechanical work and uncritical submission under authorities — may now be handicaps. It would seem that initiative, together with other dynamic qualities such as self-confidence and mental tenacity, is becoming as important as static qualities such as diligence, obedience, discipline and a sense of order.

Roots of complexity

One of the most far-reaching social phenomena of the present time is the speed with which possibilities of thinking and acting are created and the complexity of living conditions increased. What distinguishes man from other living beings is first and foremost his tremendous potential to gain access to exogenous information (e.g. electron microscope), to process it (e.g. computer), to store it (e.g. optical disk), and to use it (e.g. CAM). In contrast to other living beings, this potential is not an element of man's anatomical structure. We are here largely confronted with "cognitive artificial limbs" created by man, artificial "tentacles" (Arnaut, 1987).

Progress in the last centuries has primarily been in the production of such artificial limbs. They have grown in such quantity and divergence that matters have become ambiguous and unforeseeable, confronting man with a qualitatively new situation. The theoretical background of this development is technical rationality which has dissociated the production of knowledge from the context in which it is used and its consequences evaluated (Schoen, 1983). Knowledge has emancipated itself from its dependence on human objectives, and in turn defines the limits of what is possible.

The term "complexity" here draws attention to the number and intricacy of these artificial limbs with which man has extended his genetic potential of understanding and designing the world; in addition, these tentacles increasingly develop a life of their own which is less and less understood and manageable by their creator. For example, Weizenbaum (1984) comments on the impenetrability and independence of military computer networks. The Spanish philosopher Arranz (1987) draws the picture of an octopus growing ever more and longer tentacles, making their control increasingly more difficult.

Possible reactions to this complexity:

A pessimistic answer assumes that the octopus will eventually collapse under the sheer weight of its tentacles, that through loops of positive feedback man will reach a point of no return, after which his artificial limbs can no longer be controlled and will destroy themselves. In this view chaos is programmed and immanent in human development.

An optimistic answer would accept the possibility of breakdowns of some parts of the system but would claim that man learns from them since, up to now, for every problem a technical solution has been found and this would also be the case in the future.

If the first answer is considered inacceptable and the second not convincing, there is a third possible answer which seems more realistic: it implies that an adequate reaction to complexity is decentralisation, i.e. to move decision-making to the periphery or to the base where the tentacles operate and come into conflict with each other. It also implies that the reductionist tenets of technical rationality should be complemented by a reflective attitude towards practical situations. Emphasis would no longer rest solely on the question, "Did I get what I wanted?", but also on "Do I like what I got?". This second question is reflective and refers not only to the intended results of human activity but also to its non-intended side-effects. Answers from this second question could bring about solutions that increase control over the tentacles of human endeavours. Finally, it implies that people who are affected by the positive and negative consequences of men's artificial limbs must be ready to influence actively the situations they live in.

This third answer, which is neither optimistic nor pessimistic, contains the basic challenges for the educational system of the future. The increasing complexity of economic, public and private affairs makes it more difficult to anticipate the corresponding demands on behaviour and to analyse them in detail. The less it is possible to predict the values and abilities necessary for functioning in situations, the more young people must be prepared to take initiatives themselves, to reflect and decide on their own, to seek and accept responsibility.

Towards a new culture of teaching and learning

The school does not remain unaffected by these secular changes. There will have to be a shift of traditional balance in the design of teaching and learning, showing that learning does not only come through instruction by "those who know for those who do not know", but that it can also be seen as:

joint searching, joint experimenting and joint investigation into possible future scenarios. In the case of this type of learning, neither the subject nor sometimes even the problem in its entire complexity are always obvious. (Fischer, 1985, referring to Peccei, 1979)

Some of these changes will be the following:

— As well as the school, the environment will become an important place of learning. Here the term "environment" does not only comprise the natural environment but also the technical, social, economic, cultural and political environments;
— In addition to the textbook and the teacher as sources of knowledge, literature, expertise from various fields and experiences derived from different activities outside the school context will gain in significance;
— The construction of knowledge for the identification, definition and handling of problems will be of increasing importance. In particular, the contribution of formal education to defining problems will improve in value, as this competence can be far less automated than the abilities required for solving problems;
— The construction of knowledge to cope with insecurity will increasingly require co-operative processes among students and teachers, and will need to reduce the existing isolation in teaching and learning;
— The static values that have so far characterised the demands on teachers and students will have to be supplemented by dynamic ones: initiative, independence and individual responsibility.

Such a shift of balance requires changes in both the self-image of teachers and in the structure of schools. The increased complexity of tasks will require not only a decentralisation of initiative, responsibility and competence from school administration to the teacher and to the individual school, but also from the teacher to the individual student.

Strengthening the competence and self-confidence of teachers and students to initiate and monitor development processes themselves will thus become a major new perspective of the educational system. This includes both individual and institutional learning processes.

Individual learning processes:

— Extension of the teacher's repertory of competences to challenge the student to take the initiative in developing and planning learning and to benefit from the variety of school experiences;
— Extension of the teacher's ability to investigate and improve instructional activities and contribute to a common professional knowledge base.

Institutional learning processes:

— Further development of co-operative structures within schools and of forms of co-operation between schools and non-school institutions;

— Promotion of "atmospheric" conditions, challenging and facilitating individual initiative and self-organisation among teachers and students.

Peters and Waterman's study (1982) of the "secret of success" of selected American enterprises has disclosed features that are also relevant for schools:

— In successful enterprises, there is an active search for problems rather than an attempt to hide them; and once they are identified, they are resolved co-operatively rather than through the hierarchy;
— Problem identification is valued more than proposals for their solution;
— Control comes after the result and not before it: "Try it and we will see if it works" replaces "Ask for permission before you do anything";
— Informal communication is highly valued to disseminate good ideas;
— Employees are trusted that they are taking a personal interest in doing their tasks well;
— Achievements are recognised in a variety of non-spectacular ways;
— Customer service and satisfaction are valued, as is clients' perception of the services of the enterprise.

These are some basic ideas that provide meaning to activities. They are shared and modelled in the behaviour of the management. On the other hand, Peters and Waterman found that less successful enterprises contradict nearly all of these characteristics: there are more negative than positive sanctions; rules replace shared ideas; restrictions and control replace the active search for meaning, and political leadership replaces moral leadership.

Implications for the in-service training of teachers

In-service training of teachers (INSET), too, requires a shift of balance:

i) The well-established pattern of INSET (centrally or regionally organised events supplying predefined subject matter) will have to be complemented by other forms of training in which teachers are not recipients but active planners and developers of their in-service education (Posch, 1984). The general social expectation that teachers should undergo in-service training must be actively strengthened during their learning. On the other hand, a variety of INSET frameworks will have to be developed in which teachers themselves can fulfill their own demands of in-service training;

ii) The practice of holding in-service training at education centres outside the school ought to be supplemented by in-service training inside, where discussion and the testing of innovations would occur within the institutional context of the teacher's workplace;

iii) The traditional orientation of individual in-service training should be extended to groups of teachers or to the entire teaching staff of a school;

iv) The practice of school management "allowing" in-service education should be replaced by an active school-based INSET policy promoted by the principal and supported by the administrative bodies (Posch, 1987), and part of the in-service training brought in line with development perspectives of individual schools;

v) The practice of presenting educational and subject matter knowledge to teachers ought to be supported by structures (such as counselling, technical and financial assistance, incentives, etc.) which would stimulate, qualify and help teachers or groups of teachers to investigate their situation, to define problems, implement innovations independently, and test and stabilize them institutionally (Altrichter and Posch, 1990).

These five proposals concerning a shift of balance cannot, however, substitute the existing offers of in-service training, just as static elements of the learning culture cannot be replaced by a dynamic orientation of the school. The task is rather to find a new balance between the two, taking account of social changes.

II. THE ENVIRONMENTAL PERSPECTIVE

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Modelling and experimental sciences

What exactly do we mean when we talk about the experimental sciences? In the life sciences, for example, we mean that if various individuals exhibit a large number of shared characteristics, then it is reasonable to assume that they will respond in the same way to a given substance. Our belief that a substance is harmless to man is not based on observation of its effects on every single man in the world, or even a billion men, but on a limited sample of a few thousand or perhaps tens of thousands of men.

We commonly scale down other parameters too, such as time. When we carry out experiments on human beings, we monitor the effects of a treatment for perhaps one year, which is not long enough to determine whether, for instance, a substance is carcinogenic or mutagenic. The assumption is that if a single dose of a substance does not prove to be toxic within a year or two, then it will not be toxic over a longer period of time. In other words, the time parameter is scaled down.

It may sometimes prove useful to shrink spatial dimensions such as length, surface area or volume — a technique known as modelling. This is a concept readily absorbed even by children of pre-school age, chiefly with respect to spatial dimensions, since many toys are simply small-scale models of real objects.

The concept of modelling is rooted so deeply in our minds that discovering its limitations can be startling, as was the case when an attempt was made to obtain mechanical effects from thermal phenomena. While mechanical effects such as sway in buildings may be studied using models with reduced spatial dimensions, heat effects cannot be studied using the same method, the main reason being that the speed at which heat is propagated through a given medium is independent of the size of the object. Consequently, the study of the steam engine posed conceptual problems that even scientists were surprised to have to admit.

Modelling and ecology

The concept of modelling is now under attack from other directions. Man is beginning to realise that his activities have considerably damaged the environment and that

even greater unseen dangers lie waiting in the future. This awareness has kindled interest in the environmental sciences and ecology, notably among the EEC member countries, who have approved or are in the process of reviewing procedures for an "assessment of environmental impact". However, ecology cannot be studied on the basis of models. It might be countered that laboratories for studying ecology exist and probably make use of models. But the experiments carried out in such laboratories are designed to investigate the hypotheses of a variety of specialised sciences, whereas ecological studies make use of information drawn from a variety of sciences ranging from astronomy to geology, chemistry and biology.

Ecologists study not only the environment's ability to conserve biomass volume but also the numerical balance of species present before the introduction of man-made changes. This approach to conservation is frequently criticised as sanctifying nature and everything not directly related to or caused by man, yet it derives from concepts propounded by Malthus and Darwin: the size of the birth rate with regard to survival possibilities (identified by Malthus) initiates a process of selection/evolution (identified by Darwin), which makes it highly probable that billions of years of evolution and selection will produce the greatest possible biomass in a given environment through an optimum quantitative balance of species.

Since its frame of reference is of a living system, ecology faces problems created by the fact that living organisms are seldom identical, even when they belong to the same species or genus. A difficulty also arises with the relationship between biological functions and time. Knowing that it takes longer to establish carcinogenic or mutagenic properties of a substance than it does to demonstrate its toxicity, ecologists have to study the period of time that an insecticide will remain active in the soil or water, the time that it takes to kill adult insects or larvae, the time that insects will take to develop resistance to it, and the time that any human organism absorbing it will take to eliminate it.

The number of such difficulties, which are inherent in the study of zoology, botany or microbiology and therefore the study of individual species, is multiplied in the study of ecology, i.e. the system of interrelationships between species, which defines the level of complexity of an ecosystem. The complexity will be all the greater when taking into account the relationship between various species and human behaviour. The more complex the scenario, the harder it becomes to make the kind of scaling down (in terms of space, number, etc.) that is typical of the experimental sciences.

Difficulty of predicting

It would seem that ecology is a science based more on experience than experiment. The difficulty, or rather impossibility, of predicting the impact of man's actions on the environment by means of the reductionist methods of the models of the experimental sciences can be illustrated by one example among many:

The use of just one tractor can be damaging to the environment if the layer of clay in the soil is not thick enough to support its weight, and gaps appear through which pollution can reach. However, when European farmers first started using tractors on a large scale in the 1960s, they could not have predicted that the result would ultimately

be higher fish prices and an increased incidence of cancer. The tractor is responsible for both phenomena in that it replaced the draught animals and thereby broke up the traditional bond between animal rearing and crop growing.

Once animals had been replaced by the tractor and were no longer needed on farms as beasts of burden, there was a growing tendency to separate arable farming and husbandry. This separation only came into effect after animals had lost yet another of their roles on the farm — that of providing fertilizer — when the chemicals industry started to produce artificial nitrates. In turn, livestock farmers increased labour productivity by treating manure waste from cowsheds and thereby making a clean break between arable farming and animal husbandry. The water table is now polluted not only with animal waste but also with artificial fertilizers that the soil, progressively depleted of its organic components, can no longer retain. Phosphates lead to eutrophication of surface water — lakes — and of seawater in coastal areas; hence the rise in fish prices. Nitrates, too, increase eutrophication, and they pollute the water table as they form nitrites that the human body subsequently converts into nitrosamines, which are carcinogenic. In this way the use of tractors has increased both the price of fish and the incidence of cancer.

No one could have predicted this development in the 1960s. An isolated analysis of the use of tractors would not have given the slightest hint of the potential impact. Nonetheless, the eutrophication of the Adriatic is a dramatic reality of which the whole of Europe is aware and, owing to the chain of cause and effect, is largely the result of farm mechanisation. We are not talking about just one tractor or the few tractors that would be used in an experiment; this catastrophe is the result of mechanising agriculture throughout the entire Po valley and using not thousands but tens of thousands of tractors over a period of 30 years. Eutrophication has merely a brief period of latency, and its effects are clearly visible over large areas in the form of malodorous viscous water, which makes it relatively easy to determine the causes.

Matters are different with regard to pollution of the water table. It has been noted that it takes on average 30 years for nitrates to reach the water table subsequent to their use on cultivated land. Cancers too have a long latency period of about 20 years. Therefore, although the industrialisation of agriculture in the Po valley first began on a large scale during the 1960s, we shall only begin to count the costs in terms of an increase in cancer in the last decade of this century.

We now have enough material for discussion to be able to turn to the role that schools can (or should) play in its presentation. It is my belief that the school system should primarily aim at reappraising one of the most potent myths of modern culture, that of the experimental sciences. Obviously I am not suggesting that we return to the teachings that preceded the emergence of the experimental sciences; there can be no question of putting the clock back to before the time of Galileo. But we must recognise the fact that the experimental sciences scale down a large number of parameters, over and above those that I mentioned at the beginning of this chapter, not only in terms of the number of objects observed, the period of observation or the reduced spatial dimensions, but also — in what is a particularly dangerous practice, perhaps the most dangerous of all — in terms of the number of aspects exhibited by a phenomenon, a process usually referred to as "reductionism". We must realise that the experimental

sciences cannot avoid being infected, to a greater or lesser degree, with the disease of reductionism. If not, they would attempt to work from a life-size map of the realm.

To return to the example we have chosen, we can see reductionism at work when we consider a cow solely as a machine that produces milk and beef (i.e. food), thereby disregarding the fact that it also supplies work and fertilizer. This example shows that reductionism — isolating various facets of reality that should be viewed as a whole in terms of their interrelationship — leads to the development of specific disciplines. We have seen that livestock rearing alters soil conditions, the chemical inventory of water, the survival prospects of different aquatic species, the price of fish and the incidence of cancer. It therefore involves geology, chemistry, water management, zoology, microbiology, economics and medicine. But when schools introduce these disciplines separately, as is the traditional practice, they are implicitly refusing to handle the complexity of reality.

A reappraisal of the myth of the experimental sciences is a dizzying prospect in that it seems to imply abandoning science's ability to predict. In fact, it amounts to little more than dispensing with an illusory ability. Science's relatively limited powers of prediction are illustrated by the situation in which we now find ourselves: three centuries of unbridled development in the experimental sciences have brought great progress in certain areas such as medicine, but have brought us to the brink of disaster with regard to the balance of the ecosystem.

In addition, and again with specific reference to the biological sciences, the most revolutionary discoveries are made not through experiment but on the basis of experience — that is, not through making controlled changes to reality but through observation of reality itself. Malthus brought about a radical change of direction in the life sciences without performing a single experiment, without even being aware of having mentioned biology, by making an observation that, once he had made it, became obvious to everyone.

Even Darwin carefully refrained from carrying out experiments. He made one adventurous voyage in his youth during which he amassed observations that he spent his whole life ruminating over. Perhaps it would be more accurate to say that he made one experiment: he experimented with non-intervention. He left a stony field completely untouched for 30 years, preventing anybody from disturbing it in any way; after 30 years he was able to note that the field was no longer stony because the stones had sunk below the surface owing to the action of earthworms. He thereby identified one aspect of the interaction between living organisms and the soil, one highly significant aspect of the ecosystem that we are grievously mistreating.

However, there is something disquieting in the fact that we should have to place greater reliance on a science based on experience rather than experiment with regard to our powers of prediction. Our concern stems from the fact that in many cases experience teaches us the consequences of interference only once we can no longer reverse the effects. This is due to one of the most reassuring features of the ecosystem, its capacity to absorb considerable upheaval without being damaged. Yet it is paradoxical that a cause for concern should stem from a reassuring characteristic.

Let us take another example. In order to protect a fruit-tree from parasitic insects, we treat it with an insecticide that also happens to kill pollinating insects. However,

since there are ten different species of pollinating insects, the fruit-tree ecosystem can cope with the interference and is still regularly pollinated, even when one of the pollinating species disappears; it will continue to bear fruit even after seven, eight or nine species have disappeared. However, the day that the most resistant species, the tenth, finally disappears will be a disaster, a disaster that we will mistakenly refer to as "unexpected". It is merely the mechanisms of stabilisation that make destabilisation an unexpected and catastrophic event once a certain threshold has been exceeded. This threshold effect is proverbially referred to as the "straw that breaks the camel's back".

Nobody disputes the claim made by doctors that illnesses are fought before the symptoms appear; yet it is hard to understand why this way of thinking never prevails when we discuss living organisms or ecosystems. Perhaps this inconsistency is linked to the fact that there are billions of human beings, of whom we all know at least a few dozen, whereas there are few ecosystems and we are only familiar with at most one or two of them.

This consideration also indicates to us that ecology is a science that does not particularly lend itself to making predictions; and we are in great need of the ability to foresee the results of our actions. Can you commit yourselves to attempting to teach children how to predict the unpredictable? The answer would obviously be "no"; but we tend to shy away from the obvious. Were we to couch the question in less provocative terms, we could perhaps ask ourselves whether it might not be possible to teach children to recognise fortuitous links that are not in themselves obvious; in which case the answer would undoubtedly be "yes", since the task is definitely possible albeit difficult.

The path that is open to us then becomes clear: acquiring the habit of reflecting upon non-obvious fortuitous links that can already be recognised is perhaps the best way to learn how to predict some of the less obvious consequences that mankind's actions may have in the future. Traditional disciplines do not offer the most stimulating channels for teaching this subject, more effective stimuli often being found in newspaper articles — and not necessarily those on pollution. Analysis of any situation in which there is no obvious relationship between cause and effect can help illustrate a similar relationship in another situation. Laborit, when discussing the teaching of biology, maintained that it is more important to provide a structure, i.e. a set of relationships, than information. If this is true for biology, then it is even more true for ecology which investigates denser and more complex networks of relationships.

In the national report by Michaela Mayer (1988*b*) we learned that Italian primary schools which have set up environmental education projects emphasize the importance of establishing an emotional link between the child and nature; however, we also learned that this emotional link is not with nature in general but with one specific environment. This seems to be a highly significant aspect of environmental education; if schools are aware of its importance they can greatly contribute to its development. I am working here on the same type of case study as other schools in the CERI project, and my investigation of the "case" of the tractor — that is, the consequences of using tractors and the conditions under which they may be used — is based on a structure (as Laborit would say) of prime importance: feedback.

Even children can understand, with a minimum of information, that the widespread use of tractors facilitates the use of artificial nitrates, and that the increased use of nitrates makes it easier to use tractors. It proved difficult for the tractor-manufacturing industry and the fertilizer industry to reach a certain threshold in terms of sales, and during this initial period the sales of both products rose extremely slowly; once the threshold had been reached sales, however, grew increasingly quickly.

It is of no importance that this structure is based on tractors and nitrates — that is, two products which have had a large impact on the environment. Perhaps the link between tractors and nitrates is more obvious to children living in the country; those in cities might find it easier to understand a feedback structure were they to be asked to draw upon experience of things with which they are more familiar. All children know that when people buy cars they prefer to choose a make for which spare parts are readily available. However, spares are readily available only for makes that are already common; consequently, makes that are widespread always tend to become commoner.

There are other types of experience which are shared by all children, regardless of whether they live in the country or in cities, and which can provide feedback structures. All children have been told at some time in their lives: "Don't scratch it, you'll only make it worse". Thus, small skin irritations that itch and are made worse by scratching are an example of positive feedback. The important point is that a child is able to convert information into a structure. That a skin irritation is made worse by scratching is not an important piece of information; that a child is able to recognise the common thread between the price of motor cars and the development of skin irritations, however, represents the acquisition of a highly significant structure with regard to the understanding of both natural and social phenomena. The environment educates society, and society educates the environment.

Another example of feedback illustrated by the case history of the tractor is seen in the use of tractors encouraging farmers to choose artificial fertilizers such as phosphates and nitrates, and discharge animal manure — which is itself rich in phosphates and nitrates — into the natural drainage system. There are therefore too many phosphates in the environment.

Phosphates are responsible for the eutrophication of surface water: they produce such a large increase in organic substances that when the latter decompose they consume all the oxygen present in the water and fish die. Owing to the number of dead fish, the amount of decomposing organic matter increases and more fish die; this is the process of positive feedback. Thus nitrates initiate positive feedback. Artificial nitrates are, in fact, toxic to many organisms in the soil, particularly those that produce natural nitrates.

Consequently, treating the soil with artificial nitrates deprives the land of organic components, thereby increasing the speed at which nitrates are leached into the ground water and inhibiting the production of natural nitrates. The increased leaching of nitrates and decreased production of natural nitrates results in a net loss of fertility which must be remedied by increasing the input of nitrates. Thus, once nitrates have been used on the land an even greater quantity must be used subsequently, as though nitrates are a kind of heroin to which the land is addicted.

Feedback

What kind of feedback prevails in a living system? Is it positive or negative? A distinction must be made between different levels of feedback: the health of a single organism is governed by a process of homeostatic control — that is to say, negative feedback; the breakdown of negative feedback and its replacement by positive feedback generally results in sickness (although not all illnesses are of this type). This is the situation referred to as a vicious circle, and means that it is much easier to detect positive feedback in a self-sustaining system than negative feedback. An understanding of how the organism works according to this cybernetic scenario provides insight not only into health and illness but also into how medicine works, and helps us understand why treatment of the symptoms alone will never bring about a cure. In modern times, which have seen the discovery of cybernetics and a growing interest in "ethnoiatrics" (generally symptomatic), these issues are attracting considerable attention.

With regard to living systems, by contrast, we discover that the prevailing situation is one of positive feedback. To take the extremely simple example of total biomass, we find that exponential growth in volume over 3 500 million years has transformed a tiny drop of microscopic matter into huge forests teeming with life, which is therefore an example of long-term positive feedback on a grand scale. However, by about two hundred million years ago, long before man's first impact on the environment, this process of growth was over. Clearly negative feedback then took over. Of what kind? As yet we have hypotheses but no theory.

The populations of a stable ecosystem respected by man, should any still exist, are interrelated through negative feedback systems that establish a balance within it. These feedback systems, however, are only apparent to researchers working in specialised scientific institutes. Our children must content themselves with what they can find in books and must take information on trust. The simplest ecosystem to describe is that found in the Arctic, in which there are three links in the food chain. The hare population governs the lichen population and vice versa; the hare population also governs the lynx population and vice versa. Hunter and prey govern each other's numbers and vice versa, in the sense that an increase in prey will produce an increased number of predators, but an increase in predators will reduce the number of prey.

These are mechanisms easy to understand but difficult to verify; one reason is that ecosystems are generally more complicated than the ecosystem found in the Arctic, mainly owing to the presence of species that play a greater number of roles (such as herbivores which eat several species of grass), or different species that play the same role, for example by pollinating the same plant. It is hard to gain an overview of the whole system, since it is difficult to obtain information directly, which is why we have to accept the information given to us by specialists.

Schools must provide a feedback by trying to identify it within society. For example, a village is starting to lose its inhabitants, and shopkeepers are closing their stores. Since there are fewer facilities, the exodus speeds up. This is a case of positive feedback: people are leaving because others have left. However, the abandoned houses are of interest to young couples who have delayed getting married because they could not find anywhere to live. Craftsmen who had been planning to leave therefore post-

pone their departure because they now have work to do in renovating old houses. This sets up negative feedback; the exodus slows down and the population of the village is stabilized.

If a school focuses attention on such an area and takes part in the life of the district or village, the children will attempt to understand the rules governing these processes. First they will collect information: the bakery closed because there were fewer customers. They will then realise that an initial cause and effect is responsible for a whole series of causes and effects which, in some cases, speeds up the initial process until there is a total imbalance. By contrast, in other cases it may slow down or even halt the initial process, thereby establishing a new balance. The recognition of such trends in different areas of experience amounts to acquiring a structure, which enables subsequent experiences to be interpreted faster and with greater accuracy — which in turn enhances the ability to make predictions.

Chance

These abilities, however, are inevitably limited through the existence of chance. Today's generation attaches less importance to chance than previous generations; and tomorrow's generation will see its importance fall still further, since it is growing up with the computer and will therefore have new powers to widen the range of factors that can be taken into account. That generation will be able to measure parameters accurately, store records of various situations and collate results with extraordinary computing powers. The role played by chance will be increasingly limited — but not completely eliminated.

Some of the reasons have already been examined as to why experimental sciences cannot be considered to be sciences of certainty. The reductionist premises on which they are based, despite allowing ever higher degrees of probability, do not confer absolute certainty. Even were we to eliminate every premise and carry out studies on a map as large as the realm itself, we would never be able to make a prediction free of an element of chance.

The laws of fortuitousness, which preclude making predictions about a single or individual object, nonetheless allow statistical forecasts to be made that increase in accuracy the greater the number of objects or individuals under consideration; or, in terms of dimensions, the closer the map is to the size of the realm itself. Sometimes, however, we use the term "chance" to refer to not only the absence of a known cause, but also to that of a cause which can be determined. In the first case we say that the universe is deterministic, in the second that it is non-deterministic. Modern physics tells us that both universes exist. There is one universe with large dimensions in which a sufficient amount of information allows us to predict all events, and another universe made of molecules, atoms and sub-atomic particles in which events are absolutely unpredictable.

There are those who may think that the environmental changes that concern us are those which occur in the large-scale universe and that they should therefore be predictable had we enough satellites and computer networks. However, between the micro-

cosm in which chance holds sway and the macrocosm in which chance is only equal to our lack of information there are two bridges, one of which is genetics.

Modern molecular genetics has fully confirmed Mendel's theory of corpuscles and hence the fortuitousness of the separation and rearrangement of hereditary characteristics. It has proved Darwin right to consider individual variability to be due to chance, but wrong to accept the Lamarckian theory that acquired characteristics are inherited. Today we know that genetic mutation takes place at microcosmic level, where it is enough to substitute one particular atom in one particular molecule in the nucleic acid of a sperm cell to open up a new evolutionary path to the living system and hence the ecosystem.

Around 3 500 million years ago a perfectly fortuitous and unpredictable event took place in the microcosm, a mutation that made it possible for blue-green algae to synthesise chemical compounds in light by dissociating water molecules and liberating oxygen. This ability gave the algae such a selective advantage that they proliferated, at which point a layer of oxygen started to accumulate in the atmosphere, which in turn resulted in the formation of an ozone layer. This ozone layer filtered out deadly ultra-violet radiation and made the emerged land masses habitable for living organisms. Around 500 million years ago the great invasion started with the first tentative mosses, and 100 million years later the emerged land masses started to green over with vast forests (today we are destroying both the forests and the ozone layer).

Environmental education

Nobody would suggest teaching children quantum physics before their final years at secondary school, yet it is essential for the cultural baggage of teachers to include the notion of a bridge between the microcosm of the unpredictable (the mutation of blue-green algae) and the macrocosm of a planet-wide phenomenon (the formation of the ozone layer). Teachers must have this cultural baggage because they have to protect children from the lure of computers which can persuade them that an increase in the number and sophistication of computers will eventually make everything predictable. A significant aspect of environmental education must be teaching that, although we can widen the scope of our forecasting, some areas will always remain unpredictable. To forget this would be yet another sign of that dangerous technological pride which is currently costing us dearly; remembering this means having the foresight to remain constantly on our guard so that we can recognise the unpredictable as soon as it appears.

Children adopt a practical approach. If a problem is real, not one invented by the teacher but one that adults have not been able to solve, they will make a real attempt to find an answer. Teachers must encourage them in such a way that pupils themselves set the rules of the game, the basic rule being that the remedy must not be worse than the disease. Children are capable of setting out potential costs and benefits, i.e. the structure of a calculation, regardless of whether they have exact figures. For example, their proposed solutions to the problem of eutrophication of the Adriatic, together with their awareness of the difficulties involved, include:

— Prohibiting the use of phosphates in detergents but making sure they are not replaced by NTA which is itself a health hazard (zeolites could perhaps be a substitute, but pupils need to know whether its production causes pollution and how much energy it requires; it would only be partially effective since it would solve merely 2 per cent of the problem);
— Banning the chemical industry from discharging phosphates into the sea (pupils need to work out where they could be dumped safely, perhaps by advertising in every newspaper in the world to find out whether somebody could use them);
— Pumping a substance into the sea that kills algae but does not harm fish (perhaps there is no such substance, otherwise it would already have been used);
— Digging a channel in the bed of the Adriatic with a slope to drain polluted water into the Ionian sea where it would be dispersed (there might be a danger that the sand also slides away and there is no beach left at Rimini);
— Building a large pipe at the mouth of the Po to collect polluted water and take it out to sea (again, there might be the danger of losing sand and beaches);
— Building treatment plants for all sewage channels and livestock farms, and on all rivers, to collect phosphates drained from fields under cultivation (pupils need to work out the cost and impact on the land from which the necessary stone and sand for concrete is taken).

Some of these suggestions are clearly thoughtful and others less so; however, the impractical proposals serve a useful purpose in prompting discussion and reflection on the consequences of our actions. The fact that pupils did not suggest reviving the old method of using animal manure to fertilize the land shows that schools — which we expect to offer information rather than structures, and ideas rather than methods — even fall short in terms of the information they provide.

Can schools teach children to be aware of the future? In today's world not only children but also adults have great difficulty in identifying with their own future. Have there been other periods in history in which people have lacked awareness of the future? Yes, the Roman empire economist Columella relates that field workers ate their own corn seed. These men had lost not only their future but also their past through being reduced to slaves. They recovered their future when slavery gave way to serfdom, when they acquired the certainty that the land on which they worked would have to feed them not just for one, two or three years but for their entire lives, and that after their death it would have to feed their sons. This marked the beginning of a vast undertaking by farmers: the creation of Europe's farmlands with their own hands. In the words of René Dubos, they grew to love the land. It was not schools that encouraged this passion but deep-seated social innovation.

Today, Europeans are no longer slaves — they are free in a way they have never been before. Yet they have lost their future and are destroying their past. They are destroying their past by polluting the earth of which they are the heirs and custodians — or rather, the temporary owners. They have lost their future in the sense that they plant poplars instead of nutmeg trees, sunflowers instead of the olive trees that prevent landslides.

Why do they plant poplars? Why do they sow sunflowers? Why are modern goods not made to last? Why are there still people living in Queen Theodolinda's houses in Pavia? Why are houses built in the ninth century in Mala Strana in Prague still standing, and why will the houses we build today become dismal broken-down shells within a few decades and not even have the dignity of ancient ruins? There is clearly something in our society that cuts us off from the future, which is even more dangerous than cutting ties with the past. It is a feedback process that we must break out of, a vicious circle that somebody must break.

Schools can be an instrument for maintaining the current momentum of valuing only the present. However, can schools not also be the place where the vicious circle is broken, the place where children receive their birthright: the past and the future?

III. THE INDUSTRIAL PERSPECTIVE

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The question of environmental education is important for everybody, but especially for students, as they will be the producers and consumers, the scientists, politicians and journalists of tomorrow. They have to be taught how environmental problems should be analysed and solved. In this chapter we will deal with the complexity of these problems, their historical roots, the environmental effects of production and products, the need for personal understanding and action, and finally with proposals for environmental education and for co-operation between industry and schools.

Why did the environment issue become so important?

- There are real environmental problems which everybody can notice;
- There are others which scientists can only detect with complicated instruments (which is difficult to understand and creates fear);
- Citizens in industrialised countries are well educated and enjoy a high standard of living. They can afford to take care of the environment and feel urged to do so;
- Problems of specialisation (biologists and engineers speaking different languages; businessmen thinking differently from civil servants) make the necessary co-operation for environmental protection very difficult.

How did all this develop?

- In the springtime of human existence, mankind was weak and lived in small settlements within nature which had overwhelming strength. Now mankind has spread all over the globe, and nature has to be protected in reserves;
- Production and consumption per person have increased considerably and are accentuated by concentration in large cities and industrial enterprises;
- Many of our synthetic products are very steadfast, cannot be recycled by biological processes, and accumulate in the environment;

— After the Second World War we experienced a phase of quantitative and qualitative growth; we have now entered the phase of optimisation and communication. We have to find out what we really need and want.

What should we do?

We have to optimise benefit, risk and cost. For too long we have considered the cost-benefit relation only, not having been aware of (or not willing to consider) the risk dimension. This has resulted in a situation where mass media shocks us daily with horror messages on risks. But now we have to proceed to action, we have to avoid or reduce risk by risk analysis and risk management.

Mankind has gone through several stages in trying to solve these problems. The first idea — born already 200 years ago — was to reverse the trend of development: back to nature and away from industrialisation. This idea failed, since the majority preferred to maintain their standard of living. The second idea is to stop further growth. Population growth should be restricted; economic growth has to be retained in developing countries, and qualitative growth is still needed in industrialised countries; we have to change our technologies and our products, trying to reduce waste and pollution as far as possible; lifetime concepts have to be developed for all products, taking into account all steps from raw material and energy production, through to production and use of the final product and even to its disposal.

Protecting the environment by changing our industrialised world will cost an enormous amount of money. But who should pay? The governments? They have not enough money, and citizens are no longer willing to pay higher taxes. The producers? They would have to increase the prices of their products, and differences in national environmental standards would result in imbalances in international trade, maybe even in unemployment. The consumers? This group — very often — is the weakest one and the least informed.

In order to resolve these discrepancies and to spread the financial burden in an objective and justifiable way, the OECD developed the "polluter pays principle". Pollution can be reduced most efficiently if legal and financial responsibility is allocated to the actual polluter in each step of the production/consumption and disposal chain. This principle is also most valuable from an educational point of view: it creates the motivation and understanding for personal responsibility and activity. Most important also is a better understanding for sustainable methods to solve environmental problems, as there are many examples of amateur measures creating more problems than solutions.

Environmental protection and industry

Environmental protection has to start with management and become a top priority of the enterprise, ranking equally with profit optimisation and long-term protection of the existence of the enterprise. An environmental manager needs to be appointed and given the task of analysing the environmental situation of the enterprise, its strengths

and its weaknesses. A strategy has to be developed to improve the situation regarding raw materials and energy consumption, the processes applied, products fabricated and the minimisation of waste and pollution.

Generally as a first step, the existing process technology is retained but adapted by adding effluent-purification units. Fabrication of existing products is continued, but harmful components are substituted by less damaging substances. Sooner or later, completely new process technologies have to be developed and new product types designed. When this happens, legal and technical standards need to be taken into account and priorities set, in order to solve the most pressing problems first and applying the most cost-efficient measures. The enterprises which will be most efficient in environmental protection will be the ones which succeed in motivating all their employees in this task. This development has been seen as the internal aspect of environmental protection and industry, but there exists a very important external aspect as well:

- Industrial enterprises should keep close contacts with the major groups of society, in order to be aware of their needs and proposals: for example, with scientists to get early warnings on possible environmental problems and ideas for their avoidance or solution, with teachers and journalists in order to inform the population of their own problems and activities for environmental protection;
- Industrial enterprises should keep close contacts with politicians and civil servants, as their priorities for environmental measures depend very much on the environmental legislation and standards passed and administered by these groups. Enterprises prefer authorities to set environmental targets, but they want to retain enough freedom to choose optimal routes to meet these targets in order to save time and money. Industrial enterprises expect environmental regulations to be appropriate: costs to avoid environmental damage should be lower than the cost of the damage itself. In addition, environmental regulations should not be so strict that innovation is no longer possible, since without innovation neither improved production processes can be developed nor better products designed;
- Industrial enterprises should improve their contacts with consumers in order to optimise the benefit-risk-cost balance of products and services, otherwise an over-emphasis on risk reduction might impair benefit or increase cost, and the most environmentally compatible products could miss their purpose if consumers were not prepared to buy them;
- The main environmental problems can be solved only jointly, by co-operation between producers and consumers, authorities and scientists. More use should be made of the problem-solving capacity of industry, based on its techno-economic know-how and its project-oriented research potential.

What are the issues to be dealt with in environmental education from the point of view of industry?

- Education should be fact-oriented and applicable to real-life situations;
- A solid basis of knowledge is needed in the fields of natural sciences, technology, economy and ethics;

- The scientific analysis of an environmental problem should be followed by an assessment of existing technical problems in solving it and the cost of this solution;
- As more and more reliable techniques are developed to analyse and solve problems, they should also be taught in schools;
- An understanding of complex and interrelated systems has to be developed. The power of international competition and the need for international agreements should be recognised (to avoid countries with low environmental standards exporting their products to countries with higher standards, and thus create unemployment);
- Training in priority-setting, and thinking about alternatives are necessary: there are too many problems to solve all at once and many fruitless confrontations could be avoided if more flexibility were created by producing alternatives;
- Emphasis should be given to problems of timing and to their constraints (often much time is lost by endless discussions or by trying to enforce a 99.9 per cent solution, taking many years for realisation, whereas a 90 per cent solution would be in hand within months);
- Young people must be taught to recognise, reduce and accept risks. Mankind has never, and will never, live in a zero-risk world; all we can do is to recognise this fact and to act accordingly;
- Students must be motivated to bear responsibility and to take initiatives, and be willing to co-operate in community projects. Whilst they should be taught to define and express their own opinions clearly, they have also to accept that there are other points of view. The process of jointly finding the best solution to a given problem should be one of mutual information and motivation, and not one of confrontation and accusation.

How should environmental education be structured in schools?

- Environmental education, like all forms of education, should be appropriate to the age of the student and the type of school he is attending. Environmental education in elementary schools should be linked to situations in family life, with neighbours, with people on the street and in shops, with craftsmen and farmers. These are situations even small children can understand and evaluate;
- In secondary schools, environmental education should be linked with the different subjects taught. Here the concept of complexity can be introduced, explaining why different teachers or population groups may hold different opinions on the same topic. Most important is the inclusion of case studies in educational practice. This creates the possibility to come close to real-life situations and demands personal responsibility and co-operation;

- In vocational schools, the educational approach needs to be more practical. The main emphasis should be on energy saving, on the need for new technologies, on safe ways to dispose of dangerous waste materials, on interrelations between ecology and the economy, and on the need for lifelong learning;
- In colleges where teaching languages, arts and theoretical subjects are taught, a better understanding of technical and economic problems should be developed, with excursions to power plants, factories, waterworks and waste treatment plants being arranged. Case studies should help to illustrate that the analysis of a problem must be followed by efficient actions to solve it;
- In technical and economic colleges, emphasis should be given to ethical and social questions, and a better understanding developed of psychological and sociological problems. Meetings with authorities may be useful for understanding different views on technical or commercial achievements;
- School systems where environmental education is taught by biologists only are inadequate. Teachers of all subjects, offering the specific knowledge of their disciplines, should recognise the need for interdisciplinary co-operation (exemplified, if possible, by joint case studies);
- Each school subject would emphasize a particular aspect of environmental education:

Biology:	Creating understanding of optimal living conditions for individuals, population groups and ecosystems; explaining the need for animal testing, and the possibilities to substitute it by other test systems;
Chemistry:	Explaining chemical reactions during production, use and disposal of substances used at home or in industry; trace-analysis, its pros and cons;
Physics:	Describing the different types of energy, their efficient transformation and optimal use;
History/Social sciences:	Describing the historical development of environmental pollution and protection; illustrating social dimensions such as environmental protection vs. full employment;
Geography/Economics:	Explaining economic prosperity as a basis for environmental protection; locating a factory to examine environmental standards; illustrating the promotion of environmental protection by financial subsidies or sanctions;
Religion/Philisophy:	Developing and assessing value systems, standard of living vs. quality of life;
Mother tongue:	Training for controversial discussion;
Foreign languages:	Providing a basis for access to international information on environmental problems and protection measures, and a prerequisite for participation in international conferences.

Conclusion

Environmental education is for teachers — as environmental protection is for engineers — a new dimension in their professional life. In order to enable them to educate their students in this most important field, they need additional information and experience. This entails a need for lifelong personal education, not only regarding one's own discipline in its relation to environmental problems but also in compensating and complementing the contributions of disciplines such as the natural, technical, economic and social sciences. In order to gain a better understanding of real-life situations, excursions to industrial enterprises and environmental authorities are valuable, as well as to regions where nature has been damaged by environmental pollution and to those where nature has been restored by environmental protection measures. Even more competence is acquired if teachers co-operate in environmental protection projects, either with parent associations or within their own communities.

Finally, I would like to emphasize that industry is very interested in establishing close contacts with teachers, and in co-operating in environmental education. I think we have a lot to offer: videofilms and slides to be used in lessons, data collections and other background material, invitations to excursions, discussion and project groups. The Federation of Austrian Industry, for instance, has produced and distributed more than 2 000 kits containing this type of material.

It is our joint interest to educate young people, who are able to create a high standard of living and quality of life for mankind, whilst taking good care of nature. Continuing communication and co-operation is necessary for us all to reach this goal.

IV. THE POLICY PERSPECTIVE

Kathleen Kelley

OECD Secretariat

Is there a policy for environmental education? This question is more complex than meets the eye, for although the present intensive resurgence of the "environmental issue" is evident to all, the actual translation of what to do about the urgent environmental imperative in policy terms, and especially in educational policy terms, has not been resolved. The environment seems to be first and foremost an economic issue. Although "environmental economics" has been considered in the past as more or less a "soft" part of economics, and therefore not in the forefront of industrial decision-making, it was in fact originally an integral part of the notion of economy: according to some experts, the science of economics is the study of human behaviour in relation to scarce resources. Economics emerges from the conflict between man's increasing and changing needs and the scarce resources of the planet; as such, economics is the science of dealing with scarcity.

Industrial economics of the 20th century has been built on the logic of economic growth, development and the production of surplus. This rapid expansion of surplus economy and the increase in consumerism has taken attention away from the reality of scarce natural resources. A number of environmental shocks in the last few years have again placed the question of scarce resources at the centre of the policy debate. These problems include deforestation, the greenhouse effect, acid rain, the destruction of the ozone layer, and the increasing desertification of certain parts of the world. It has become evident that environmental concerns must be integrated into economic analysis.

Steps in the evolution of a policy

Here, perhaps, it will be best to start with the latest pivotal event: the publication in 1987 of the report by the World Commission on Environment and Development (the Brundtland Report), which marked a new era of thought on environment and economics. Its main focus is how to translate the notion of sustainable development into policy terms that will be effective rapidly enough to save the world from major environmental disasters. In June 1988, the Royal Norwegian Ministry of Foreign Affairs, commenting on the question addressed by the report on international co-operation on economic development, offered a direct challenge to the OECD:

To promote the Commission's recommendations, the OECD's political leverage, the Organisation's breadth of professional expertise, and its analytical capacity, represent an important instrument in the efforts to develop a better understanding of the need for sustainable development in both industrialised and developing countries.

The OECD responded to the Brundtland Report by examining the implications of its work for the study, analysis and promotion of such sustainable development, and in November 1988 the Organisation held a seminar to discuss how it could strengthen its work in keeping with the recommendations of the Commission. Jim MacNeil, former Secretary-General of the WCED, stated:

We found, and our report demonstrates, that given all the trends, our economic and ecological systems have now become totally interlocked in the real world. To ignore one is to jeopardize the other. Global warming, for example, can be seen as a form of feedback from the Earth's ecological system to the World's economic system. So can the ozone hole, soil degradation, deforestation, species loss and many other phenomena. But, although our economic and ecological systems are interlocked in the real world, they remain almost totally divorced in our institutions.

Somehow, we must learn to bridge this gap. Section III (of the report) *mentions our proposals for institutional change in six priority areas, and I won't repeat them. Underlying them is the conviction that we must broaden our concept of "environmental" policies, and "environmental budgets". Given the interlocked nature of economic and ecological systems, we must begin to look at economic and financial policies as "environmental" policies, along with energy, agriculture and other sectoral policies, and we must also look at the budgets they command as "environmental budgets", to be deployed with "ecological eyes".*

Is education a part of this broadened concept of environmental policies? Should education also be looked upon now with ecological eyes? Education is the last but not least of the sectors addressed by the Norwegian Ministry:

The World Commission's recommendations for creating sustainable development necessitate the capability to consider development in an ecological perspective. This means that planners and decision-makers must have the necessary knowledge and insight concerning the ecological limits set by nature. This is still not an integrated part of general education neither in industrialised nor developing countries. Nor is it part of the special education provided for planners. Therefore, extensive measures must be taken to educate persons employed in the systems of public administration. It is also important that decision-makers have the knowledge required to make the right and necessary decisions. Therefore it is also necessary to educate politicians

The Government will: seek to ensure that the competent international agencies with which Norway cooperates take the initiative to strengthen education for sustainable development both within and outside the formal systems of education.

The Brundtland Report is the latest international policy input to encourage governments to act on environmental problems. However, the report is not the first of this kind of international policy promotion strategy. In 1972, the Stockholm Declaration of the United Nations Conference on the Human Environment created the United Nations

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Environmental Programme (UNEP); in 1975, the Helsinki Conference called for mutual co-operation with respect to environmental problems in Europe; in 1980 the World Conservation Strategy was developed, and in 1982 the United Nations World Charter for Nature was passed, stressing the importance of environmental protection.

In June 1983, at a meeting organised by the Austrian Society for the Protection of Nature and the Environment, the Declaration of Vienna touched directly on environmental policy and environmental education:

> *Following several international recommendations, it has been possible to make environmental education a leading principle of education relevant to many different subjects taught at schools, and as such put it into practice. But there is still a tendency in some European countries to confine environmental education merely to subjects dealing with biological considerations, which entails the danger of limiting it to specific conservation concerns only. Environmental school education also has to encompass subjects such as arts, literature, philosophy, religion, economics, sociology and geography.*

In May 1988, the Council of the European Communities and the Ministers of Education passed a resolution on environmental education. Here again, the preamble states the links between environmental conditions and economic activities, and stresses the integration of environmental concerns in other policies of the Community, pointing out that the Community has a privileged position in promoting policy development in its member states, and naming education and training in environmental matters as priority areas.

On the wider international level, the resolution considers the OECD along with UNESCO as important partners in setting up school networks and international information exchange concerning concepts of environmental education and measures for implementation. The objective of environmental education is stated as that of increasing public awareness of problems and finding appropriate solutions, and to lay the foundations for informed and active participation of the individual in the protection of the environment and in the prudent and rational use of natural resources.

A number of guiding principles are set out in this resolution:

- *the environment as the common heritage of mankind,*
- *the common duty of maintaining, protecting and improving the quality of the environment as a contribution to the protection of human health and to the safeguarding of the ecological balance,*
- *the need for a prudent and rational utilisation of natural resources,*
- *the way in which each individual can, by his own behaviour, particularly as a consumer, contribute to the protection of the environment.*

Recommendations for action to be taken by member states within the limits of their own specific educational policies and structures include:

a) *Each member state, taking account of regional particularities and in cooperation with parents, local bodies and other relevant bodies, should promote the introduction of environmental education in all sectors of education, including vocational training and adult education. It would appear appropriate that its current*

policy on environmental education should be set out in a document and made available to schools and other educational institutions.
The document should take account of the fact that environmental education is an interdisciplinary subject of relevance to many fields of teaching;

b) *For the carrying out of these tasks, it would appear important for the relevant authorities of the member states:*
   - *to give consideration to the basic aims of environmental education when drawing up curricula and organizing interdisciplinary courses,*
   - *to encourage extracurricular school activities by means of which theoretical knowledge of the environment acquired in school can be put into practice,*
   - *to take appropriate measures to develop teachers' knowledge of environmental matters in the context of their initial and in-service training,*
   - *to undertake specific action to provide teachers and pupils with appropriate teaching materials.*

It would appear appropriate to prepare, implement and improve these priority activities with the help of pilot and research projects;

c) *Specialists who are particularly concerned with environmental problems should, through appropriate vocational training facilities, have the opportunity to acquire new knowledge or bring their knowledge in this field up to date. Relevant environmental content should also be introduced into initial vocational training and university training, with a view to influencing those with future professional responsibilities in a direction which is most favourable to the conservation of the environment and natural resources.*

The gap between policy statements and curricular implementation

Although the international policy thrust to promote environmental education does set the scene for understanding policy trends in the OECD Member countries, it cannot actually influence the establishment and application of a concrete educational policy on environmental issues. Practically all Member countries officially address the environmental issue within their formal education system. However, in many countries the gap between policy statements on paper and the actual translation of environmental objectives in curriculum terms is quite significant.

Why is environmental education so difficult to put into practice? Environmental school initiatives are developing rapidly in Member countries, they are becoming more sophisticated, and they are dealing with an increasingly greater variety of issues that is going far beyond "nature conservation". Projects are involving the community, parents, local, and sometimes national, decision-makers, and yet environmental education in most cases still carries the image of a "marginal activity" in terms of the curriculum.

Despite agreement on the importance of educating future citizens towards environmental awareness, is it the global nature of the environmental issue that is so difficult to deal with by educationalists? The perennial question of where to include environment within the curriculum still applies: should it be part of the science curriculum, of geo-

graphy, social studies, philosophy, political science, economics or across the whole curriculum? The environmental issue is multi-faceted, complex and perhaps more difficult to master than most clear-cut subjects that have a long history of curriculum development. Some specialists of environmental education claim that the problem that besets environmentalists and educationalists alike is the lack of a generally accepted and applicable philosophy for environmental education.

Many specialists argue that the main purpose of environmental education is to foster changes in attitude which result in changes in behaviour. The important objective is to educate future decision-makers who are environmentally conscious and can enter the environmental debate with sensitivity and knowledge in finding viable solutions.

The second main value of environmental education lies in its emphasis on contemporary, pertinent topics and material. The field is attractive and relevant with obvious applications and clear orientation towards the impacts of and implications for man and his activities. Such a multidisciplinary subject area could thus rightly claim to be a point of synthesis in the curriculum and a focal point for future curricular innovation and change (Park, 1980).

Some say that certain unexpressed difficulties may be due to confusion over the underlying philosophy for environmental education. Park claims that one problem with environmental education is the lack of a broad consensus on appropriate ideological and political frameworks within which to evaluate the environmental activities. Although there is agreement among environmentalists that the environment is a problematic issue of major importance, beyond this there is a certain bewilderment about the most pressing dangers, what are their causes and how they can best be treated.

Park goes on to say that there is a similarly broad spectrum of ideologies within environmental education, and so the danger of formal indoctrination and of peddling prescribed viewpoints on given environmental issues is heightened. Any form of environmental education must deal with issues which are ideologically sensitive, whether it does so implicitly or explicitly. The real challenge is to create a learning system which will invite the learner to open his mind and explore complex issues in a rational manner. A key element in the design of such a learning system is the balance between awareness, knowledge and the development of skills (Park, 1983).

Active learning and teaching of environmental issues

As stated in the Part One of this report, the main objective of the CERI project on Environment and School Initiatives has been to combine an active learning/teaching process with the environmental issue. A prominent aim of environmental school initiatives is to develop and stimulate "dynamic" qualities in students — that is, to encourage and promote the taking of initiatives, the exercise of independence and creativity, the willingness to take responsibility for the acquisition of knowledge and for actions.

On the teaching side, this has involved the creation within the school context of a variety of experiences inviting participation by students whilst providing them with choice as well as with assistance in identification of problems, in information gathering and self-evaluation. The involvement of students has implied both intellectual as well as

emotional challenges, and has called for interdisciplinary co-operation on the part of teachers.

It was clear to participants from the beginning of the CERI project that such teaching/learning situations would affect "ordinary" classroom work and would certainly call for innovative strategies to carry out such ventures successfully. The environmental concern was not limited to the natural environment of the school, but involved students also in their social, cultural, economic and technical environments. This was seen as transgressing the boundaries of the school and opening it up as a place for reflection and action on the environment.

As illustrated by the case studies in Part Two, the work concentrated on school projects and did not explore in any depth the question of environmental education policy in the participating countries. However, the co-ordinator from each country was asked to prepare a national report that set the background for understanding the school initiatives which had been undertaken.

The following issues were suggested as a framework for writing the reports: co-ordinators were asked to set the national context in which environmental school initiatives could be understood. They were asked to describe the structure of the school system, how management was organised, centrally, locally or in individual schools; who has the monitoring responsibilities, and how this could influence the initiatives. The training, selection, status and further education of teachers was regarded as a significant variable. Other considerations were curriculum issues such as who designs it, its status and form, and how much freedom is given individual teachers within its formal boundaries; whether environment is a separate subject of study and, if not, which subjects are taking up the issue; what, if any, are the obstacles within the curriculum to environmental initiatives? The structure of the examination system was also considered as relevant; for example, the selective function of exams and whether or not they are controlled by the teacher.

Reporters were asked to outline the aims of the projects that had been chosen and to describe how they had organised the actual carrying out of projects, such as co-ordinating, supporting and finding resources, and how these projects fitted into other related national activities. Further aspects of project work — such as the effects they had on knowledge acquisition and the changing of student attitudes, student participation in project planning, the incentives they provided to both students and teachers, the effects on the motivation of students with learning difficulties — were all elements of a type of general evaluation of outcomes. Such variables as the use made of expert information, of the methods of dissemination applied to communicate project work to others (visual arts, drama, music, etc.), of the possibility of replicating the work in other situations, were considered as useful information in understanding the experience.

Finally, co-ordinators were asked to try to analyse the experience of the two years' work in terms of the implications it could have on policy issues: for example in developing the curriculum, in the training of teachers, both in-service and pre-service, in terms of support facilities, and regarding reforms in the examination system. The information contained in the reports is extremely various, for differing reasons, but primarily reflects the great differences in the status of environmental awareness of the education

systems. The extent of the data found in these reports does not necessarily reflect the nature of the school initiatives that were undertaken.

The reports were intended only as contextual background to the initiatives, and not as any systematic evaluation of the projects. Hence, the following summary of information (taken mostly from the national reports) is very approximative in nature and has no systematic or analytic pretensions.

ENVIRONMENTAL POLICY PERSPECTIVES BY COUNTRY

Austria

Educational regulations are constitutional matters, and any changes must be agreed to by the two major political parties. The curriculum is determined by the Federal Ministry of Education for all levels of schooling, after consultation with the major interest groups in society. In the case of compulsory schools, the Provincial School Boards can be authorised to adopt additional provisions of the curriculum, depending on local conditions.

Environmental education is directly or indirectly addressed in the syllabi of several subjects and in all types of school, although there are considerably fewer references in syllabi for vocationally oriented schools than for those stressing general education. The same is true for project type of instruction emphasizing student initiatives and independent learning. However, there are a number of recent initiatives that stimulate environmental projects. e.g. the national programme "Environment has a History", and an increasing willingness of the administration to provide support and encouragement. At present, however, the infrastructural provisions in support of environmental initiatives are far less developed than the general expectations for teachers to initiate them.

Belgium

In the Dutch-speaking sector of the Belgian school system, there are three types of schools: the official state schools, the state-subsidised town and province schools, and the (state-subsidised) free schools. In all the different systems, the school has significant autonomy in how to apply the curriculum. Activities that go beyond the classroom, however, need to be approved by the headmaster and the central inspectorate. No provisions are made for additional funds, which means that schools must support themselves. Some expenses are covered by the normal school budget, others are borne by the students.

The curriculum is usually broadly defined, and it is up to the individual teacher to interpret it. Many teachers, however, do keep to official definitions and advised procedures. Recently revised curricula contain directives for an approach that is more closely related to environmental concerns and project education. Case studies on the local environment are encouraged, emphasis is given to action-oriented forms of education, and there is an increased accent on problem-solving and training development.

Denmark

The Danish education provision states that the *Folkeskole* prepares pupils for taking an active interest in their environment, for participation in decision-making in a democratic society, and for a share in the responsibility for solving common problems. Although no curriculum exists for environmental education as such, teachers are free to choose their methods themselves and this makes it possible to deal with environmental issues in a creative way throughout the curriculum which is already phrased broadly enough to permit this.

In addition, the *Folkeskole* has a tradition for extensive experimental teaching which is planned and carried out by the teachers, and changes in the Education Act have several times been in the nature of a legalisation of existing practices. Despite this positive attitude, however, the number of experiments in environmental education is still very limited. A major initiative has been the establishment of a nation-wide INSET Programme in environmental education, assisting teachers to carry out experimental teaching, and developing theoretical guidelines and practical examples for dealing with environmental issues.

Federal Republic of Germany

In the Federal Republic of Germany (before the unification of Germany), education is entirely the responsibility of the ten *Länder* (or states), which means that each *Land* is autonomous concerning educational legislation, policy, administration and management. In 1980, the standing Conference of Ministers of Education passed a resolution on environmental education in which it was seen as being the task of the school to encourage environmental awareness in young people and to educate them to feel responsible for their environment. It was stated that students were to learn to understand complex relationships; interdisciplinary teaching was to be promoted, especially in the natural and social sciences; and first-hand environmental experiences were essential for students if they were to understand the conflicting interests that exist in the complex reality of ecological, economic and social influences.

From the 1960s on and especially since 1980, the *Länder* have ensured that environmental issues are included in the syllabus of the relevant school subjects. However, translating these objectives within concrete school situations is not always easy. Environmental education requires the teacher to have an amount of freedom which is in conflict with the rigid organisational structure of the school. The encouragement of behaviour and attitudes favouring the environment seems to require new forms of organisation and methods of teaching which are new to most schools. Problem-solving orientation, transdisciplinary approaches and action-oriented instruction all require tangible experience for the students and therefore involve using the outside environment as a ground for learning.

An empirical investigation revealed that teachers perceive the over-abundance of syllabus material, the tight schedule, and the breakdown of total teaching time into lessons as the greatest obstacles to environmental education. Teachers found that the res-

triction of their pedagogical freedom made them less disposed to embark on promoting student activities that implied teaching outside the school.

Finland

Environmental education is part of the national curriculum but is actually translated into practice by the municipalities, and schools are expected to collaborate with them to determine the best methods for teaching the subject.

In vocational schools, environmental education is part of the practical training, and it is felt that this stimulates and motivates students to learn because it centres on real issues. The process is considered profitable for the municipalities also, producing concrete and useable results which concern the whole community.

The objectives of environmental education are not only to impart knowledge but also to teach students to be critical of knowledge, acquire the capacity for creative work, put previous knowledge to new use, have the courage to rely on one's own observations, and be able to take a stand and state the reasons for one's views. Environmental education is treated as a cross-curriculum subject because of its multidimensional nature.

Italy

Until 1974, the Italian school system was completely centralised. Although this structure was retained even after 1974, new forms of representation in the decision-making process were introduced. The principal still governs the school but is joined by a council made up of delegates from among the teachers, parents and, in the case of high schools, students. The curriculum is entrusted for the most part to the faculty board, while the class syllabus is deliberated by a class council, or interclass council as is the case in elementary schools, where not only teachers but also parents are represented. In secondary schools, students are part of this body.

Despite the centralised responsibilities, the flexibility of the system allows individual teachers great freedom to introduce innovative projects. Moreover, environmental education has been introduced in the science curriculum and is defined in the syllabus as follows:

> *The study of the effect of mankind upon the environment is closely connected with those problems handled in history and geography. Some aspects of those problems can be dealt with more deeply in the study of the physical, chemical and natural sciences. Man has in fact explored his environment to understand it, either adapting himself or attempting to tame it to his needs...*
>
> *As regards observing nature, the following activities are planned: noting the changes made on the environment and its ecosystem, in particular in the region, the effects of agriculture and other man-made conditions; observation and gathering data on the effects of urbanisation and industrialisation; identification of harmful and dangerous substances present in the environment and illustration of preventing their spread; gathering information on the possibilities offered by advanced technology for envi-*

ronmental protection and for the prevention of natural disasters. The awareness of the advantages and disadvantages of man's effect on the environment should not be confused with an unconditional refusal of technological progress.

Although environmental education is present in the official syllabus and teachers are free to initiate new projects, the national report points out some divergences: in particular, the curriculum in the compulsory school system promotes the extension of innovation in environmental education, whereas in the senior schools both the curriculum and the examination system represent barriers to this dynamic. The reporter adds that on all three school levels there is a lack of preparation towards an active approach in research and field work, and that this lack of support has made many teachers fall back on traditional methods, leaving little space for creativity, decision-making and awareness:

Indispensable for the realisation of projects in environmental education are the interest and willingness of teachers, principals and parents. Should one of these partners be missing, the project is bound to fail. For this reason, local initiatives which accept and foster these activities in the community are absolutely necessary. Herein the local authorities could play an instrumental role in financing and publicising the projects, thereby enhancing their chances for success and popularity in other schools.

Netherlands

There are private and state schools and, depending on this, the administrative structure is composed either of representatives of the local government or of the private organisation that established the school. The curriculum of the school is determined by the school board, but in fact it is the headmaster in collaboration with the teachers who actually defines what is to be taught. The national examination programme provides significant guidelines for subjects taught. Because examinations are the same for all students in a particular type of school, the content of the exam programme plays an important role in determining what is being taught.

Environmental education is considered as a newcomer to the Dutch curriculum and is not a regular subject. The emphasis on it was initially stimulated by private organisations in their efforts to inform the public about the preservation of the natural environment. However, an increasing number of schools are including environmental education in such regular subjects as biology, geography and, in some cases, chemistry. This is due either to the teacher's own growing awareness of the importance of environmental education or to the tendency to incorporate everyday life situations in the curriculum for educational reasons such as improvement of students' motivation, self-reliance and autonomy.

Recently drafted examination syllabi for the natural sciences tend to create more possibilities to include environmental education. This also originates from the new thrust of draft programmes to use everyday life items to teach the interaction of science, technology and society. An example of this new approach is the project described by Pieters (in Part Two) in which a team of science teachers is expected to produce a curriculum proposal to integrate environmental education into subject syllabi. It is also proclaimed as an "educational principle" to be considered in every subject as appropriate.

Norway

In the revised Mønster Plan for compulsory education of 1987, it is stipulated that education in Norway be based on local conditions. Each school has to work out its own curriculum. This gives teachers considerable freedom to base their teaching on local environmental issues.

The Plan presents environmental education as a multidisciplinary subject integrated into the different areas of the curriculum. Despite its official status, environmental education is not part of every local curriculum. However, there are many innovative examples of how environmental issues can be taken up in schools, and the participation of Norway in the OECD project is considered as part of the process of promulgating viable examples to be adopted by schools. The main barriers to environmental education are of a practical nature such as time schedules, transport, the examination system and required courses of study.

In the upper secondary school curriculum the environmental aspect is not as strongly emphasized as in the Mønster Plan. The overall aims provide for ecological sensitivity and international understanding, but these aspects are only present in the syllabi for the natural and social sciences. This is one reason why projects were chosen in two upper secondary schools for the work with the OECD, in order to stimulate the further development of the environmental curriculum at this level.

Portugal

Environmental education in Portugal is under the auspices of the Institute for the Environment established according to the Outline Law for the Environment of 1987. The Institute is responsible for conceiving and implementing environmental education projects in collaboration with the Ministry of Education.

The Ministry has been a passive partner, allowing for the development of courses, awareness campaigns and pilot projects within the limits of the conditions set by school programmes and timetables. However, there is reason to believe that the institutionalisation of environmental education projects by the Ministry of Environment will eventually lead to the integration of environmental education into the Portuguese education system.

The projects under way at present (see the case study in Part Two) were made possible through the efforts of interested teachers willing to do extra work on a voluntary basis. The projects are considered as complementary activities which must not interfere with the curriculum or the timetable.

Sweden

Environmental education is an important feature of the curriculum, not only through compulsory schooling but before and after as well. Environmental issues figure especially in the teaching of science subjects but are also included in civics, history and the social sciences, as well as in technological areas of study. In the lower secondary

school curriculum, ecology is one of the main areas of the biological sciences and also features in the teaching of chemistry. At the upper secondary level, environmental issues are dealt with as part of natural history in the three-year humanistic, social science and economic study programmes, and likewise in the two-year sociological study programmes.

The National Environmental Protection Board (NEPB) plays an important role in the promotion of environmental awareness. The Board therefore has a vested interest in promoting environmental education in schools. As part of the effort to stimulate this, the NEPB and the National Board of Education have recommended that the Regional Boards of Education appoint regional resource officers for environmental education. Their tasks are to support and stimulate environmental education by acting as mediators between schools and the different authorities responsible for environmental questions. The Ministry of Education has given special grants for the financing of these resource officers.

An important aspect of the Swedish approach to environmental education can be illustrated by the following response by a Swedish school to the World Commission's report:

> *A successful policy is not possible without a combination of knowledge and a popular will to change. Awareness and knowledge of environmental matters in education and research can be promoted in several different ways. The distinctive feature of the Swedish School is that we do not rely solely on regulations promulgated by the state and by government agencies — we augment them by stimulating voluntary effort by private individuals or by organisations. This stimulus is an element in a conscious policy — we do not take it for granted that the voluntary efforts will occur spontaneously.*

Switzerland

Each of the 26 cantons has full responsibility for education. The supreme decision-making bodies are the Cantonal Departments of Public Instruction, and some cantons also have a Council for Education. The organisation of how teachers are appointed also varies according to cantons: in some, teachers are elected at communal level, in others they are appointed by school committees.

The curriculum is entirely the responsibility of the cantons; it is generally defined by a special committee appointed by the Cantonal Department of Public Instruction. The curriculum design at this level is very general in its prescription and therefore leaves room for considerable freedom of individual schools and teachers. For environmental education this means that those teachers who are sensitive to environmental issues are able to integrate environmental education in innovative ways and do not particularly wish for a more prescriptive curriculum definition of the subject. However, those teachers who have less interest in environmental education can pay less attention to it because of the rather general nature of curriculum design.

In the canton of Zürich, for example, the curriculum provided a general framework in which the project on the "waste mountain" (described in Part Two) could be inserted.

At present a review of the curriculum is under way and one of the five curriculum divisions is to be "man and his environment" for primary schools. A number of curriculum plans for the future in other cantons are also in favour of new pedagogical methods that are in keeping with those practised in environmental education.

Conclusion

From this brief country survey we may hypothetically conclude that policies for environmental education are developing in the participating Member countries. In all of them there is a concern for dealing with environmental issues in one way or another within the education system. Some countries realise these intentions by tolerating individual teachers' initiatives, others by giving such broad definitions to the curriculum that space may be found for environmental education — these strategies may be rated at the "passive" end of the continuum. Those countries exercising a more "active" approach may have environmental education as an official part of the curriculum, but this does not necessarily guarantee the widespread practice of environmental education. At present, those countries that have flexible systems and provide sufficient support for teachers embarking on environmental education seem to have the greatest variety and strength of environmental initiatives.

Annex

AN OVERVIEW OF THE PROJECTS

AUSTRIA

A primary school in **Thomasroith** (Upper Austria) has developed a number of small initiatives to raise the awareness of environmental problems. For example, an "environmental pillory" was set up in front of the school at a site easily visible to everyone. The pupils (aged 6-10) collected all the waste objects they could find in the streets and around the school and attached them to this pillory. Exhibitions relating to environmental questions were organised, an environmental display case set up, mail campaigns ("Burlap instead of Plastic") conducted, and a waste separation system installed at the school.

Address: Volksschule Thomasroith, Kirchengasse 68, A-4905 Thomasroith.

At a lower secondary school in **Vienna,** eight project days on the subject "water" were organised with 70 pupils (aged 10-11) and their teachers. In the course of a one-day excursion, pupils visited sites of relevance (waterworks, water purification plant, etc.) and worked on individual assignments. In addition, there was group work during which pupils worked on specific subjects in groups and were assisted by different subject teachers. In the final stage, the pupils concentrated on assignments they had selected themselves: laying out a school pond, organising an exhibition on the subject "water and industry" and a campaign for water protection.

Address: Ganztagschule Roterdstrabe 1, A-1160 Vienna.

In **Haslach** (Upper Austria), a teacher of a lower secondary school took the initiative to purchase land in order to establish wetland and dry meadow biotopes with the support of the official authorities of Upper Austria and of funds donated as a result of a radio campaign; he also stimulated other schools to do likewise. The biotopes are taken care of by the pupils and are utilised for school projects (study of butterflies, birds, wild herbs).

Address: Hauptschule Haslach, Sternwaldstrabe 24, A-4170 Haslach.

At a private grammar school in **Salzburg,** a teacher and the pupils of one form (aged 15-16) studied the waste-water influx and the quality of the water of a heavily polluted river. They cleaned a river bed, talked to representatives of industry and to the authorities, and organised an exhibition.

Address: Privat-Gymnasium der Herz-Jesu Missionare,
Schönleitenstrabe 1, A-5020 Salzburg-Liefering.

At a grammar school in **Klagenfurt,** pupils (aged 13) in their German class analysed newspaper reports on environmental topics; they wrote fairy tales, letters to the editor, presented their position on the subject and produced a book outlining their ideas for the improvement of the environmental situation in their immediate surroundings.

Address: Bundesgymnasium und Bundesrealgymnasium,
F. Jergitschstrabe 21, A-9010 Klagenfurt.

At a grammar school in **Imst** (Tirol), a teacher and the pupils of two forms (aged 13-17) carried out several initiatives aimed at changes in the local environmental situation. They undertook these tasks in co-operation with experts, politicians of the municipality and other teachers. The initiatives included the planning and establishment of two parks in the town, and the documenting of the fauna and flora of a natural resort and activities to have it protected. The work was done outside school hours and partly within the framework of an optional subject.

Address: Bundesrealgymnasium, Füllsackstrabe 13, A-6460 Imst.

About 100 pupils (aged 14-18) of a vocational upper secondary school in **Waidhofen/Thaya** (Lower Austria) carried out group studies on various aspects of the theme "Energy and the Environment". They investigated the energy balance of their school and worked out proposals for energy economies, they wrote papers about small-scale power plants, the energy- and eco-balance of packaging materials, and about recycling methods. The work was done in a one-week intensive course with experts being at the disposal of the pupils, as well as over the whole school year in different subjects. The results were summarised in a brochure and displayed to the public at a school presentation by means of slide shows, sketches and an exhibition.

Address: Bundeshandelsakademie und Bundeshandelsschule,
Vitiserstrabe 17, A-3830 Waidhofen/Thaya.

In an upper secondary vocational school in **Vienna,** a group of pupils studying for their school-leaving examinations was commissioned by a small wine-growing community to work out a development plan. The pupils collected data on various problems in the village during one week (traffic, economic situation, tourism, etc.). They then elaborated proposals which they supported with detailed plans and presented to the population and the municipal council in a public meeting.

Address: Höhere Bundeslehr- und Versuchsanstalt für Gartenbau,
Grünbergstrabe 24, A-1130 Vienna.

Pupils of a higher vocational school in **Oberwart** (Burgenland) mapped illegal dumps in different municipalities of their surroundings and informed the public about this in lectures at schools and at adult education institutions. This initiative led to a clash with public authorities, but the pupils succeeded in this conflict as they were increasingly supported by the press and public opinion. Several illegal dumps have meanwhile been closed and in this context new jobs have also been created.

Address: Bundeshandelsakademie und Bundeshandelsschule, Schulgasse 2-4,
A-7400 Oberwart.

BELGIUM

In a secondary school of the small town **Herk-de-Stad,** ten pupils (aged 10-18) investigated the school park — a historical place full of exotic trees and plants. They organised biological excursions, installed a nature trail and put together collections of herbs, mosses and plants. With the assistance of their teachers, a study on the park was worked out and subsequently presented to the public.

Address: Amandina College, Sint Truidensesteenweg 11,
B-3919 Herk-de-Stad.

Twenty-seven pupils of a school in **Anderlecht** studied the ecological situation of their town. Independent groups investigated traffic and housing problems in a main shopping street, the functions of a highly frequented part of the town, the effects of urbanisation plans in a rural region, the quality of air and water, etc. The results were incorporated into several reports and presented to the local administration and the public.

Address: Gemeentelijk Atheneum Anderlecht, Sint Guidostraat 73,
B-1070 Brussels.

A total of 150 students of a secondary school participated in the project "Environmental Survey of the Meuse Valley" in **Maasmechelen.** What started as a small-scale schoolyard project was gradually extended into an ecological study of an entire region. Assignments in a project week in February 1988 included a presentation of the characteristics of the valley, a study of water and soil samples, a survey of the social and economic situation of the Meuse Valley, and the drafting of a regional development plan. The collected data and analyses were presented to the public through colour postcards, newspaper and radio reports, public discussions, videofilms, etc.

Address: Koninklijk Atheneum Maasmechelen, Onderwijsstraat 11, B-3640 Maasmechelen.

All teachers and students (190) of a secondary school in **Lier** participated in a nutrition project. They were helped by project-experienced teachers of a neighbouring school to elaborate studies to be carried out on different subjects by 21 groups of students in the course of the next half-year. The subjects included food production, historical development of eating and food habits, marketing, etc. The results were published in a book written by the students themselves, and presented at a press conference.

Address: Rijksmiddenschool 1, Berlaarsestraat 31, B-2500 Lier.

As part of a long tradition of annual environmental weeks at the Catholic secondary school in **Braschaat,** the project "Environmental Study of the Channel Coast" was selected. Thirty-five 5th form pupils participated in a geological, zoological and botanic investigation of a coastal strip between Cap Blanc-Nez and Boulogne (France). They took stock of the scientific facts relating to the region and investigated the effects of water pollution on the local fishing trade and mussel farming. The project was documented by a video film.

Address: St. Michiels College, Kapselsesteenweg 72, B-2130 Braschaat.

The subject of the "Heron Forest" project of a secondary school in **Antwerp** was the study and restoration of a biotope and the installation of an educational nature trail. The ecological, socio-economic and historical studies, as well as the required redesign measures, were carried out in co-operation with the authorities and private sponsors. A nature trail guide was also drafted.

Address: Stedelijke Middenschool 12, Kleine Bredastraat 2a, B-2040 Antwerp.

DENMARK

In Braendgard School in **Herning,** pupils (aged 12) of one form studied a lake into which a river flows that is heavily polluted by the waste water of a sewage purification plant. A first excursion to the lake raised questions for further investigation (water quality, flora and fauna in different parts of the lake, the development of the lake, the lake in local history). During a second excursion, samples were collected and studied, classified, represented graphically, and differences explained. The development and historical significance of the lake was dealt with by using available literature. Finally, the pupils worked out proposals for the future utilisation of the lake and presented them to the local authorities.

Address: Braendgardskolen, Mindegade 22, DK-7400 Herning.

In a primary school in **Copenhagen,** situated in the heart of an industrial zone, the pupils of one pre-school form, two 1st and two 2nd forms (aged 5-7), together with their teachers, studied environmental problems of their surroundings (in particular, the emissions of a soya factory) for three weeks. What attracted the special attention of the pupils was the discovery of dead eels, which were collected and studied during lessons. Subsequently, the responsible authorities were contacted by the children in writing, and the answers received were discussed.

Address: Skolen pa Islands Brygge, Katrinedalsvej 49 A, DK-2720 Vanlose.

FEDERAL REPUBLIC OF GERMANY

In a primary school in **Baiern-Antholing,** Bavaria, a class teacher together with his pupils (aged 8-10) developed the surrounding area of their school. On a plot previously used for agricultural purposes, a natural meadow, a village pond, a field with historical types of grain and wild herbs as well as a protective hedge were created in co-operation with parents and local farmers.

Address: Volksschule Glonn, Schulweg 9, D-8018 Baiern-Antholing.

At the *Realschule* in **Bredstedt** in northern Germany a study group of teachers and pupils (aged 13-16) converted abandoned school premises into a nature information centre, although they had no financial backing. Exhibitions and courses are held in this centre, public relations work is being carried out, and further sites for the study of environmental phenomena are being developed in the surrounding area. The information centre has meanwhile been taken over by the city and developed into a tourist attraction, thus leading to the creation of new jobs.

Address: Realschule Bredstedt, Th. Stormstrasse 35, D-2257 Bredstedt.

In a secondary school in **Frankfurt** *(Wöhlerschule),* the biology teachers co-operated to develop the immediate surroundings of the school together with their pupils (aged 11-18). They set up a pond, a wild meadow, a "green classroom", a school garden, and planted wall creepers. In addition, an ecostation was installed which is being taken care of by the school and serves to inform the public and for further teacher training. The pupils were involved in the planning of all the projects. Funds were raised by a variety of activities, including the sale of products made by the pupils themselves (e.g. buttons).

Address: Gymnasium Wöhlerschule, Kleine Höllbergstrabe 1,
D-6000 Frankfurt/Main 50.

FINLAND

The city administration of **Espoo** set up a domestic animal park and entrusted a higher agricultural school, the Överby School, with its care. The school opened the park, its agricultural and horticultural installations, nature trails and the bird house to wider groups of the public and in particular to the schools and youth groups of the area. Activities carried out in the park include camp schools, agricultural courses for school classes, action programmes for youth groups (who may, for instance, grow and sell plants there), and guided tours. These activities are carried out by the teachers and students of the school outside school hours.

Address: Överby Skolor, SF-02940 Espoo.

The vocational forestry school in **Evo** planned and set up a nature park. The occasion for this was the 150th anniversary of the Finnish national epic poem Kalevala. The project was carried out in co-operation with the city administration and financially supported by the woodworking industry. The activities (planning, building, planting) were accomplished within the framework of ordinary school lessons.

Address: Vocational Forestry School, SF-16070 Evo.

The Länsi-Pori School in **Pori** is a general education secondary school with an emphasis on art. Teachers and students (aged 13-19) organised an "Art Day" on environmental issues. Each age group selected a topic (e.g. "My Pori", "Parks I Dream of" and "Towards a Better Environment") and prepared it within the framework of ordinary lessons. On Art Day, the groups of students were supported in their work by local artists. Pictures were created on different materials using different techniques, and they made sculptures, graphs, sketches for the painting of houses in the city, etc. A great variety of products was exhibited and some objects (e.g. painted paper bags) purchased by the city.

Address: Arja Kujansuu, Mikont 30 as 34, SF-28100 Pori.

In Leppävaara School in **Espoo,** a town planning project was undertaken. Working in groups, the pupils (age 16) of one form selected an area of the town familiar to them, developed ideas for the redesigning of individual zones and made corresponding plans. Some groups were assigned to replant a residential area, considering existing conditions. The work done by the pupils (plans, studies on the life in town and on the environmental situation, illustrations) was subsequently exhibited. The project was integrated into the teaching of geography, social studies and art subjects.

Address: Leppävaara School, Veräjäpellonkatu 4, SF-02600 Espoo.

ITALY

Two teachers of a primary school in **Serre/Salerno,** together with about 40 pupils, studied and documented the situation of an ecologically endangered wetland area (Oasi di Serre/Persano) where there was a plan to build a factory likely to produce waste water. The pupils conducted an opinion poll on the public's attitude to the protection of the oasis. Supported by the World Wildlife Fund, they visited the oasis, examined the fauna and flora, and carried out activities such as animal censuses. Their conversations, interviews and personal experiences were compiled in a small brochure written by the pupils and edited by the teachers for the information of the public. A visual and dramatic realisation of the pupils' experiences at a special school presentation, and the general interest roused by their four-month involvement in the preservation of the riverside, contributed to the construction of a canal by which the waste water of the factory is diverted.

Address: Scuola Elementare di Serre, Via XX Settembre, I-84100 Serre/Salerno.

Three teachers of a school in the coastal town of **Monte di Procida** carried out ecological studies on three levels, together with the pupils of one form (aged 12):

- Study of the coast: Analysis of the flora and fauna, of the soil, of water movements (low and high tide) in the course of the year, and their influence on organisms, meteorological parameters, etc.;
- Study of the influences of human interventions (construction of a new port) on natural ecosystems, and the social and economic development (by interviews with representatives of the authorities, with the public and with experts);
- Study of natural and experimentally manipulated living conditions (light, temperature, salinity, pollution, etc.) in the Mediterranean aquarium of the school.

Address: Scuola Media A. Vespucci, Via Panoramica,
I-87070 Monte di Procida.

In **Mantova,** five vocational upper secondary schools co-operate to perform a continuous study of the water quality and the degree of pollution of ground and surface waters in individual communities.

The activities are co-ordinated by the students themselves (aged 18-19) and financed by the municipality. The responsibilities of the students range from the selection and drawing of samples, the chemical, bacteriological and microplankton analysis, to the reporting of results to the responsible authorities. The Water Analysis Project is part of the normal curriculum, with 13 teachers and students of 20 forms being involved.

Address: Istituto Tecnico Industriale Fermi, Strada Circonvallazione,
I-46100 Mantova.

Working in groups, 11-14 year-old pupils of the secondary school in **Loreto Aprutino** studied the environment of their mountain village which has a population of 7 000. They observed the relationship between aspects of the rural environment and the social, economic and cultural living conditions (professions, dialects, customs, everyday family life, etc.) of the inhabitants. The material collected on excursions, and the data derived from their experiments and interviews, were assembled by the pupils for an exhibition on rural civilisation in the local museum.

Address: Scuola Media St. G. Rasettin, Loreto Aprutino, I-65014 Pescara.

In the secondary school of **Moena**, a small mountain village, students carried out several projects with their teachers. The objective was to illustrate interrelations between the industrial, agricultural and touristic utilisation of the surrounding area, and the condition of the environment. This was documented in a video film. The students also established a co-operative to distribute biologically grown apples, studied the natural nesting sites of birds and the effect of providing nesting boxes, and performed an experiment to check the photo-degradability of polyethylene carrier bags in comparison to photo-biodegradable ones.

Address: Scuola Media Don Giovanni Jori, Via Nazario Sauro,
I-38035 Moena Trenta.

NETHERLANDS

A group of teachers of a comprehensive school in **Almere-Haven** developed teaching materials on the energy of the future (heat, light and food) under the title of "How will life remain worth living?". The interdisciplinary course comprises 40 lessons and includes assignments for the study of the immediate environment of the pupils (aged 14) and ideas for discussions and experiments.

Address: State Comprehensive School de Meergronden, Marktgracht 6S,
NL-13S3 Al Almere-Haven.

Six teachers of a comprehensive school in **Deventer** developed teaching materials on "the value of water" for 15 instruction units, comprising issues such as water purification and procurement, life in water, pollution, etc. The units consist of basic subject matter, tests and optional tasks to stimulate student involvement. As a side-effect, a video film was produced by one of the authors with four students, in co-operation with a local television company.

Address: Christian Comprehensive School "Revius", POB 298,
NL-7400 AG Deventer.

NORWAY

A comprehensive school in **Trysil** offers its pupils (aged 15) a course in survival training during which pupils traverse the wilderness by canoe for several days, find their own food, and make geological, biological and ecological studies. For the older (16 year-old) pupils a course (one day per week) on hunting and life in the wild is offered with instruction in the relevant skills.

Address: Trysil Ungdomsskole, N-2420 Trysil.

The comprehensive school in **Skogn** is one of 14 schools that participate in the project "Radioactivity, the Environment and Health". Three times per year, pupils (aged 14-16) collect samples (water, plankton, soil, fruit, etc.) in the framework of their biology, ecology, chemistry and physics classes, systematise and prepare them for the measurement of radioactivity. Subsequently the values from all participating schools are entered into a joint data base. At one of the schools, the pupils are also involved into the organisation of the project.

Address: Skogn Ungdomsskole, N-7620 Skogn.

Two schools in **Overhalla** are involved in the project "Archeology at School". In co-operation with the archaeologists of the local museum and a scientist of the University of Trondheim, and in the framework of their natural sciences, civics, history and language classes, pupils (aged 15) documented historical relics, reconstructed the changes of the landscape on a map, rebuilt Stone and Iron Age dwellings, and cultivated a field with Iron Age methods. The pupils wrote texts on their local history and dramatised a study on the living conditions during the Iron Age.

Address: Overhalla Barne- og Ungdomsskole, N-7863 Overhalla.

The project "Action for the Benefit of Water Quality" was carried out by a vocational secondary school in **Ski** near Oslo. It developed from a campaign against pollution of water through phosphates. The project was integrated into the lessons of several subjects (social sciences, marketing, EDP, languages) and included a study of the drinking water reserves, measurements of the fresh-water ecology and limnology, an analysis of the state of nutrition, market analyses, visualisations and literary expressions of experience.

Address: Kontra Upper Secondary School, Dromtorveien 31, N-1400 Ski.

PORTUGAL

At a secondary school in **Amadora,** pupils (aged 14-15) studied in groups the historical development, the present situation and future perspectives of their home town (a satellite town of Lisbon) in the framework of their geography classes. With support from the local authorities they collected a large number of data on economic, cultural and demographic aspects, and analysed and used them as background information for proposals for the improvement of the quality of life in their town.

Address: Escola Secundaria da Venteira, P-20700 Amadora.

SWEDEN

In **Landskrona,** the environmental and health authority commissioned experts to illustrate the most important environmental problems and to present proposals for their solution. The contributions were published and made available to the public. In co-operation with adult education institutions, study circles for discussion of the book were established and training courses for teachers offered. Several schools participated in the discussions and exhibited pupils' work. Stimulated by this experience, the authority initiated a separate "Pupils' Programme on Environmental Protection". Two pupils (aged 12-14) from each of several classes were invited to training days (for example, one day was dedicated to traffic problems). Subsequently, they reported on their experience to their classmates, and this was followed by the elaboration of proposals for improvement to be presented to the authorities.

Address: Albonoskolan, Fabriksgatan, S-26 137 Landskrona.

Bratteberg School is situated on the island of **Öckerö.** An attempt was made to reorganise school life in order to counteract the negative effects of the economically difficult situation on the island. An alliance of teachers, parents, tradespeople and others was founded to help overcome the isolation between the school and the population by means of projects, and to give pupils the opportunity to take an active and creative part in the cultural and economic life of the community. Numerous projects were implemented, which were partly of a long-term nature. Pupils established a fish farm, a greenhouse, a studio for radio productions, and a wind-power plant. One-third of the time available for lessons is used to carry out the projects. These are financed by the alliance, but they even partly finance themselves as they are commercially utilised.

Address: Brattebergskolan, S-43 090 Öckerö.

In a school in **Paryd,** pupils (aged 9-12) studied the water of two lakes in the municipality of Kalmar which had been heavily polluted by acid rain. They also sought contact with the local population which had given up hope of an improvement of the situation. The school developed a programme to improve the water quality by supplying lime, and is implementing it with the assistance of the public authorities.

Address: Paryds Skola, S-38 024 Paryd.

SWITZERLAND

A kindergarten and the primary school of **Hinwil** near which a waste incineration plant is situated are involved in the project "KEZO". "Waste lessons" are held for pupils of different age groups by specially trained teachers. The lessons have the purpose of informing pupils about waste problems and acquainting them with various possibilities of reducing waste (separation, composting, etc.). The project is financed by the Abfallfranken, a public-duty body on waste.

Address: KEZO Projekt, CH-8340 Hinwil.

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